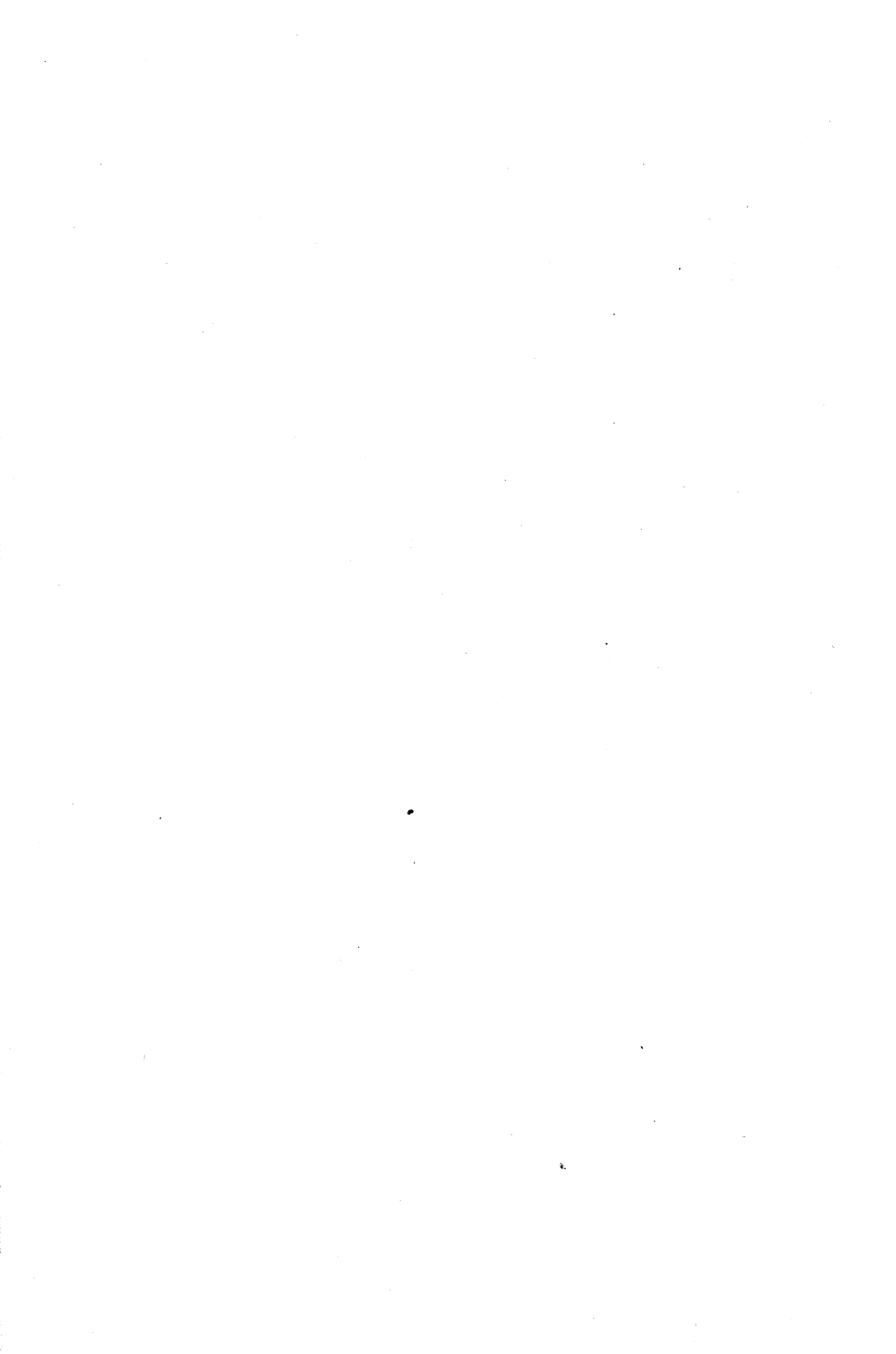


PHILIPPINE
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FIFTEENTH ANNUAL REPORT OF THE DIRECTOR OF THE BUREAU OF SCIENCE

PHILIPPINE ISLANDS

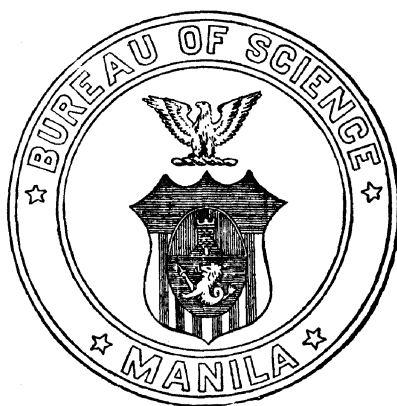
TO THE HONORABLE
THE SECRETARY OF THE INTERIOR

BY

ALVIN J. COX

DIRECTOR OF THE BUREAU OF SCIENCE

FOR THE YEAR ENDING
DECEMBER 31, 1916



MANILA
BUREAU OF PRINTING
1917

FIFTEENTH ANNUAL REPORT OF THE DIRECTOR OF THE BUREAU OF SCIENCE

THE GOVERNMENT OF THE PHILIPPINE ISLANDS,
DEPARTMENT OF THE INTERIOR,
BUREAU OF SCIENCE,
Manila, January 1, 1917.

SIR: I have the honor to submit the following general statement of the activities of the Bureau of Science from January 1, 1916, to December 31, 1916.

During the year the Director and his staff have been in demand by manufacturers, teachers, contractors, Army and Navy officials, sanitarians, practitioners, dairymen, sugar growers and other agriculturists, geologists, engineers, metallurgists, wholesale druggists, mining and dredging operators, consuls, merchants, and others for information on a great variety of subjects. Besides hundreds of interviews I have received many inquiries by mail, which the following will serve to illustrate:

MANILA, November 27, 1916.

Dr. ALVIN J. COX,
Bureau of Science.

DEAR SIR: Enclosed please find check for \$75 as requested. You will kindly get the following paper pulp materials for me—A bale of Talahib grass, a bale of Cogon grass and one bale of Nipa Palm, each weighing 300 pounds. In the woods, I would like a log about 10 or 12 inches in diameter 3 feet long of the following. Cupang, Talisay, Palosapis, Teluto, and Laoan. * * * Will call at your Bureau Tuesday p. m. Thanking you for your early attention to the above—and for other favors,

I remain, yours truly,

MANILA, November 21, 1916.

We have an inquiry for Soya Oil from one of our friends abroad. We should like to be advised whether this is produced in the Philippine Islands.

Yours very truly,

MANILA, November 12, 1916.

* * * At one time a circular was issued by the Bureau in which it had a sample of paper made from cogon so it might be that you have some information that will be a help to me along a line that has been bothering me for some time. The hemp waste from the knives makes good paper but on our places it is going to fertilize the ground only. What dope can you furnish me along the following?

(a) Is it possible to prepare paper pulp in a small way commercially?
 (b) What is the best way of preparing pulp from hemp waste for market?
 (c) Will paper makers buy a semicompleted pulp? (d) What is the price per pound approximately? (e) What is the price of pulp such that it would justify shipping to the states under the present freight rate? (f) If the price is sufficient what is the approximate cost of installing the smallest plant which can be run economically and where could plans and specifications for the same be procured?

In the matter of supervision, no extra expense need be counted in as I already have my work arranged so a line like this would not increase my overhead expenses. * * *

Very sincerely,

MANILA, *October 13, 1916.*

We have been informed that your Bureau has by a chemical examination classified the various qualities of Philippine Gum Copal, regularly being exported to the United States of America. We would be very thankful to you if you could let us have samples showing the different grades as classified by your Bureau. * * *

Yours very respectfully,

MANILA, *October 2, 1916.*

We refer to our recent conversation relative to exporters of crude botanical drugs, and, in accordance with same, are taking advantage of your suggestion by enclosing you herewith copy of letter from the manager of our Foreign Trade Information Bureau.

"Our friends, the above, importers of crude botanical drugs, wish to get in direct touch with foreign houses making these lines for export, and to receive quotations from such houses with regard to developing direct business."

We would much appreciate it if you would communicate direct * * * dealing with the inquiry referred to * * *. We would very much appreciate it if you could see your way clear to favor us with a copy of your letter.

Yours very truly,

BOSTON, MASSACHUSETTS, *September 19, 1916.*

It has come to our attention that you are in position to give us information regarding the price and availability of Lumbang Oil. Kindly send us such information as you may have regarding the use, preparation and adaptability of this oil, explaining the details of the probability of its import in this country.

Yours truly,

ZAMBOANGA, *September 19, 1916.*

* * * I write to you for the information on silkworms, mosquitos, flies, or other insects, coal, gold, or other minerals, birds, fish, fish farms, names of plants, fungous diseases of plants, plant physiology, flowers from which perfumery is secured, different kind of soil, sugar, cholera, smallpox, tuberculosis, bacteria etc.

Thanking you in advance, I remain, sincerely,

SINGAPORE, *September 16, 1916.*

I am in receipt of your letter of August 18th, and have also received a small sample of rubber which you sent me, and I thank you for your attention to the matter.

The size of the sample which you sent me, precludes the possibility of making anything more than a small laboratory test, but from what you

say as to the quantities of the vine producing this rubber, I should think there would be no difficulty in getting together a shipment of say, 50 or a 100 pounds, for which I will very gladly pay. If I can get this quantity, I will be in a position to make some local tests, and can also send enough of the rubber home for our factory to test and to make up into manufactured goods, which in their turn will also be tested. The result of such a test, of course, will be very conclusive, and we would be in a position to place a definite value on this rubber. * * *

Yours truly,

DORKING, ENGLAND, *September 6, 1916.*

I believe that *Datura Alba*—a species of *Stramonium* or Thorne Apple—grows plentifully in your Islands. I am interested in the herb as a source of Atropine and wonder if you could have sufficient sent to me (about 2 kilograms or 3 pounds) to estimate the value of the herb, I should also like some seeds if they can be obtained in sufficient quantity.

I am, sir, yours obediently,

BRISBANE, QUEENSLAND, AUSTRALIA, *September 5, 1916.*

We have felt for some time that something might be done in Queensland waters to improve the class of sponges on the Barrier Reef, and I am wondering whether it would be practicable to introduce a number of good marketable sponges into Queensland waters, with a view to obtain all possible information on this subject, I am writing to ask whether you could assist us in the matter, and perhaps put us in direct communication with those most able to help us.

In the meanwhile properly identified specimens of such sponges are keenly desired.

Soliciting the kind favour of your reply, I am, yours sincerely,

MANILA, *July 31, 1916.*

I have received a letter inquiring the whereabouts of a large deposit of short fibre asbestos reported to have been found in these islands. * * *

I notice in the interesting booklet on the Industrial Resources of the Philippine Islands published by your Bureau about two years ago that asbestiform minerals occur in many localities.

I shall be much obliged if you will kindly give me any information with regard to this deposit, which was reported through an American channel, or if any others that are being worked, giving the names and addresses of the parties controlling them.

The inquiry comes from a business house stated to be a large buyer of this material.

I have the honour to be, sir, your obedient servant,

SYDNEY, *July 26, 1916.*

We understand that you have particulars of a patent process for extracting the oil from the matured coconut as it is gathered off the tree, instead of the usual process of first drying the nut into copra, and then pressing for the oil.

As we are large crushers of coconut oil and are interested in considerable plantations in the Pacific, we would be very pleased if you could favor us with full particulars of this process and any data which you think would be of any service to us.

We thank you in prospect.

Yours faithfully,

NEW YORK, July 17, 1916.

In one of last year's Commerce Reports, Washington, we have read an article regarding a new *Philippine Oil Nut*, the botanical name of which is "*Chisochiton cumingianus*" (Harms). * * *

This little nut contains about 45 per cent of a dark, fatty, nondrying oil that makes very good soap. We would kindly ask you to let us have a full description of the trees and the nuts, also what is the area covered by same. Also what is the commercial value of these nuts and if there are any means of exporting same from the Philippine Islands.

Any information which you could give us on the matter would be greatly appreciated, as we intend to import this nut into this market in large quantities.

Yours respectfully,

MANILA, July 5, 1916.

* * * We shall appreciate greatly any information that you can furnish us in reference to Almaciga in the Philippines.

We are considering the exportation of this gum to the United States and are interested in data of any character whatsoever.

Thanking you in advance, we beg to remain, yours very truly,

SAN FRANCISCO, CALIFORNIA, June 23, 1916.

The Bureau of Fisheries, Washington, D. C., has referred us to you for information, which we seek regarding commercial fish products obtainable in Philippine waters.

The information we desire is principally as to the presence of commercial "sardines" said to be very abundant in Manila Bay, during season. * * *

[Inquiry for authentic information concerning size and species of sardines, labor, prices of olive, soya bean and coconut oils, salt, building materials, etc.]

* * * Being in the fish-food and fertilizer business and having heard considerable talk about the presence of sardines in Manila Bay this Company would consider the establishment of such enterprise in the Philippines, providing the conditions are favorable.

If you will give us such information as you may have on this subject * * * we shall feel very much obliged to you.

Yours very truly,

SAN FRANCISCO, CALIFORNIA, June 19, 1916.

We have had an inquiry for the following minerals and would ask that you please inform us whether the same can be obtained in the Philippines.

"Mineral Ore of a Hematite base running 50 per cent or over Fe_2O_3 . Or Hydrated Oxide of Iron of red shade containing either Calcium Alumina or Silicious impurities not over 50 per cent."

If these minerals can be obtained we would be in the market for large quantities of same.

Hoping to receive your immediate reply and thanking you in advance, we are,

Yours respectfully,

SAN FRANCISCO, CALIFORNIA, May 26, 1916.

We have received an inquiry from our San Francisco friends regarding a source of supply in the Philippines for crude sulphur. We would like to

have you advise us if there are any sulphur mines being worked here and if same could be obtained in sufficient quantities for export. * * *

Thanking you in advance for your trouble in this matter.

Yours very truly,

MANILA, *May 9, 1916.*

Respectfully referred to the Director of the Bureau of Science, requesting such information as he may be able to furnish regarding the commercial possibilities of Gulaman, a substitute for gelatine.

SECRETARY TO THE GOVERNOR-GENERAL.

WASHINGTON, D. C., *May 6, 1916.*

* * * request information with regard to the production of pearl shell in the Philippines, particularly the reported discovery of new beds in the neighborhood of Polillo Island and of various parts of the Visayas, and the method of marketing. They also desire references to any material published on the subject within the last six or seven years. * * *

Very truly yours,

NEW YORK, *May 1, 1916.*

* * * We are manufacturers of glue and therefore users of "Waste parts sold for manufacture of glue" * * *. Can you inform us how we can get in touch with the tanneries producing this glue stock in the Philippines?

Very respectfully,

MANILA, *April 12, 1916.*

Can you tell me of any local dye materials which the natives might be induced to gather, not in export quantities but in comparatively small amounts? Information regarding the kind, location, approximate quantity, and method of obtaining any sort of dye material will be very much appreciated.

Very truly yours,

MANILA, *March 20, 1916.*

We are in receipt of the following communication: "There are unlimited areas of mangrove swamp in the Philippines. Is there any prospect of securing the extract or the bark in commercial quantities, at a price that will permit business?" We shall greatly appreciate your information if it is possible to secure this extract and if it is suitable for tanning purposes.

Thanking you in advance for your trouble in this matter, we beg to remain, sir,

Yours very truly,

CEBU, P. I., *March 10, 1916.*

If you will favor me with information regarding coconut milk or "water;" its value in coagulating rubber as recently discovered, etc., I shall greatly appreciate the courtesy.

Thanking you in anticipation of your esteemed reply,

Believe me, yours sincerely,

NEW YORK, *March 10, 1916.*

We * * * would respectfully enquire if you can furnish us with any information regarding a new oil nut, known as "Chisochiton Cumingianus." * * *

Yours very truly,

All of these inquiries have been replied to at length, and the appreciation of the recipients is indicated by the following selected replies:

SINGAPORE, *December 24, 1916.*

Dr. ALVIN J. COX,

Director, Bureau of Science, Manila, P. I.

MY DEAR DOCTOR COX: * * * I have visited scientific institutions in the Orient, to which people pointed with conscious pride. I was astonished at what was not done, as I had regarded it as a matter of course, and now feel that the scientific methods of the Bureau of Science are largely due to your own administrative methods, as even that institution would not run by its momentum after Dr. Freer's death.

Your work in the application of scientific methods to industry, as in tanning, copra drying, and many others, stands alone. I find that the heads of departments have been trying in vain for years to get things of that kind accomplished, but with little success. The Journal of Science is constantly quoted with respect. The Bureau of Science seems unique in the Orient. * * *

With best regards, yours very sincerely,

SANDUSKY, OHIO, *December 7, 1916.*

I beg to acknowledge your valued letter of December 6 instant and thank you for the same.

I want to say further that in all my travel and investigations throughout the world I have never found any government department and its officials and clerks so willing to give information and aid as your department has done and that it really has been a matter of surprise to me.

I wish to say further that there is no doubt in my mind that with the material and data that you have furnished me our Board of Directors will be doubly interested toward their aim of establishing a factory here for our trade in the Orient.

Yours very faithfully,

MANILA, *December 1, 1916.*

I beg to acknowledge, with thanks, receipt of twelve press bulletins of the Bureau of Science, as well as of one copy of each of the annual reports for the years 1914 and 1915. I also beg to thank you most sincerely for your kind courtesy in granting me admission to the library of your Bureau.

It will be of great help and utility to me to receive regularly the copies of the press bulletins whenever they are issued, as well as any other report or information you may care to give me from time to time.

I am, yours respectfully,

HONGKONG, *November 4, 1916.*

* * * The Bureau of Science seems to be the only organ in the Philippines that has any international reputation; this has been established principally through the "Journal of Science". * * *

I have been making studies into economic conditions, and have found the comparisons with what has been accomplished in the Philippines most instructive. I have found nothing like the work which the Bureau of Science has been doing under you to make the discoveries of science

practically useful to the country, and hope that your efforts are appreciated. * * *

With kind regards, yours very sincerely,

NABUA, AMBOS CAMARINES, *October 31, 1916.*

RESOLUTION No. 141.

By a motion of Concejal Francisco Gimenes seconded by Concejal Vicente G. Uvero,

Be it resolved by the Council, that the Bureau of Science (Manila) be asked to send to this municipality one thousand copies of Bulletin No. 57 for distribution among the inhabitants of this municipality who are devoted to the growing of sugar cane. A copy of this resolution is being sent to the said Bureau of Science for this purpose.

Unanimously approved.

I certify: That the foregoing resolution is a true copy.

MUNICIPAL SECRETARY,¹

Nabua, Ambos Camarines.

MANILA, *October 16, 1916.*

Please accept thanks for yours of October 12th, with copy of your letter of the same date to S. B. Penick & Co., New York City, which we feel confident will produce results, if the firm in question is actually interested in the importation of botanical drugs from this market, which we have every reason to believe is the case.

Yours very truly,

SAN JUAN DEL MONTE, *October 11, 1916.*

Some weeks ago, as you know, we were having trouble with our water after it was put into the demijohns, and we came to the conclusion that something was wrong with our system of sterilizing the demijohns, for our tests of water taken directly from the pipes connected with the well showed that the water from the well was absolutely pure and sterile.

I then, as you know, came to see you to get your assistance in devising some scheme of sterilization that would be effectual, and I am pleased to state that the system developed for us by the Bureau of Science is now in successful operation, making it possible for us to deliver water that comes away within the safety limits, and, as is shown by the various severe tests that have been made, so long as we do not fail to put each and every demijohn through the system properly, we are sure that the water taken from any demijohn we deliver will show safe.

For this highly desirable, and in fact, absolutely essential result, I feel that this company and the public it serves should extend to you and your assistants their sincere thanks.

Please accept this letter as expressing the gratitude of this company, and I am sure that when the public realize what has been done for them, you will have their thanks as well.

Very sincerely yours,

CLEVELAND, OHIO, *September 29, 1916.*

We have your favor of August 19 and wish to thank you for the information you have included in your favor mentioned above, also the publication which you inclosed. This information is very desirable and very interesting. We are now making some experiments with lumbang oil in a

¹ Translated from the Spanish.

limited way and the writer will be very glad to reciprocate and a little later advise you the results of the tests we are now making here.

Thanking you again for your interest, we remain,

Yours very truly,

ZAMBOANGA, *September 23, 1916.*

I beg to acknowledge with thanks the receipt of copy of the Bureau of Science Bulletin No. 54 which you were kind enough to furnish this office. This bulletin contains very valuable information for the development of agriculture and industry in these islands. Please accept my congratulations for the successful completion of this important work.

Please have furnished us with fourteen additional copies both in English and Spanish of said bulletin for distribution among our provincial governors of this department.

Thanking you for this and past favors, I remain,

Very respectfully,

SAN CARLOS, NEGROS, *September 19, 1916.*

We duly received your letter of September 12, 1916, with enclosed blueprint of your new lime kiln, for which please accept our thanks.

No doubt this kiln will prove to be a very satisfactory type and we shall be much interested in the result of a trial which, we hope, will take place in the near future.

Thanking you again for your kindness in regard to this matter, we are,

Very respectfully,

SANTA CRUZ, LAGUNA, *September 8, 1916.*

I have been interested in having my attention called to Bulletin No. 54, issued by the Bureau of Science, as posted in typewritten form here in Santa Cruz. This is, I am sure, a most valuable collection of practical information which should be spread as widely as possible. With this in view I am desirous of securing copies of this Bulletin in English and Spanish, as I have considerable opportunity of bringing these things to the attention of many of the common people.

I shall be obliged if you will kindly send to me copies of the bulletin referred to.

Respectfully yours,

CADIZ, OCCIDENTAL NEGROS, *September 2, 1916.*

Last week Mr. J. F. Armstrong, an employee of the Bureau of Science was here in Cadiz. This kind gentleman came to us hacenderos of this district and gave us news which during these many years was unknown to us. He has given us wise instruction in the milling of the sugar cane and the methods of manufacturing muscavado in a scientific way notwithstanding the antique methods which we still use.

We, the hacenderos of Cadiz, are as yet ignorant of the methods used by those of Silay, Saravia, and other sugar-producing towns, but as progressive men we are anxious to know said methods; how to obtain a good extraction of juice from the cane, to skim the juice, how to lime properly, and to obtain a good quality of sugar. * * *

All these paying methods were clearly explained to us by Mr. J. F. Armstrong during his short visit in this section, and we are convinced that it would give us very satisfactory results. * * *

For all the reasons herein mentioned, I take the liberty to suggest that Mr. J. F. Armstrong, or someone else employed in the Bureau of Science, give lectures and travel all over the sugar districts of the Philippines to

instruct the farmers, so that they, little by little, may discard the old methods which they now use to produce a poor grade of sugar, while those who know say that the soil of the Philippines and particularly the soil of this Province is exceptionally adapted for sugar cane.

Yours very respectfully,¹

SILAY, August 28, 1916.

In behalf of the hacenderos of Silay and Saravia, Negros Occidental, I wish to thank the Bureau of Science for services rendered to the farmers of these towns by Mr. Armstrong, of the Iloilo office of the Bureau of Science, in helping them sign a contract for a sugar central. Mr. Armstrong has done a great deal toward bringing a better understanding of the advantages of a central sugar factory to produce centrifugal sugar over the present system of manufacture of sugar in vogue in this Island; he has explained to the farmers the mode of operation of a modern sugar mill and in every way has helped the farmers of this district to improve their ideas regarding the milling and manufacture of sugar.

Yours very truly,¹

SAN MATEO, RIZAL, August 8, 1916.

RESOLUTION No. 66.

The President submitted the following resolution:

It is resolved: To request the Director of the Bureau of Science, Dr. Alvin J. Cox, to furnish to the municipality of San Mateo, Province of Rizal, for its file, the result of the analysis of waters of San Mateo.

It is further resolved: To congratulate the Director of the Bureau of Science, Dr. Alvin J. Cox, on his meritorious work of analyzing said waters with no other object than the good of the inhabitants of these Islands.

Unanimously approved.

I certify that the foregoing resolution is faithfully transcribed.

MUNICIPAL SECRETARY.¹

HONOLULU, H. I., July 28, 1916.

On behalf of the Board of Commissioners of Agriculture and Forestry I wish to thank you for the assistance which you so kindly rendered to our Field Entomologist, Mr. D. T. Fullaway, while he was in Manila on his way back from India, breeding parasites for introduction into these islands. Your kindness in furnishing him with a room with laboratory facilities, materials, and labor assistance in building cages, helped greatly to make Mr. Fullaway's mission successful.

You may be glad to know that he reached here with the parasites in good condition, and has been able to multiply and distribute them among the islands with good results.

Very truly yours,

MANILA, P. I., July 18, 1916.

Many thanks for yours of the 15th instant received this morning, covering looms. The information is just what I wish * * *

Sincerely,

MANILA, P. I., July 15, 1916.

Kindly accept our many thanks for communications referred to us on the 1st inst., in reference to asbestos.

Very respectfully,

¹ Translated from the Spanish.

TAIHOKU, JAPAN, *June 27, 1916.*

We feel it our duty to express our deepest thanks to you for the courtesy extended to Mr. Kosaku Ebiku, our expert, on the occasion of his visit to Manila on official mission. He has safely returned to Taipeh with pleasant reminiscences of his travel in the Philippine Islands, and it is highly gratifying to state that he had found his visit to Manila, where he was received by your good self in such a cordial manner, particularly interesting and delightful, which is without question due to the valuable aids you rendered him, and of which he speaks in very appreciative terms.

We sincerely hope that his visit to Philippines may, in future, contribute something towards the promotion of mutual interest and better understanding between the two colonies.

With highest regards and respect, we have the honour to be, sir,

Your obedient servants,

LA CARLOTA, NEGROS OCCIDENTAL, *June 10, 1916.*

Though not having the honor of knowing you, I take the liberty to express my gratitude to you and to your Bureau on account of the great interest shown in sugar work by Messrs. Thurlow and Armstrong, employees of your Iloilo office, who have brought the necessary apparatus and have analyzed sugar cane juice, bagasse, and sugar cane. * * *

Messrs. Armstrong and Thurlow have also been in various "haciendas" in this section for the same object. They have discussed with the "hacenderos" and have imbued in them the new ways and have helped them in all matters pertaining to agriculture. Their interest is such that they have even traveled at night with danger to their health, due to the rains that we had this year.

Expressing again my sincerest thanks and gratitude to you, I am,

Very respectfully,¹

MANILA, *June 9, 1916.*

I have to acknowledge, with thanks, the receipt of your letter of May 10, and appreciate very much your kindness in offering your assistance to the Philippine Trade Review, in extending the profitable relations between the Philippine Islands, the United States and foreign countries, also for placing our name on the list to receive the various publications issued by your Bureau. * * *

Very respectfully,

SYDNEY, N. S. W., AUSTRALIA, *8th June, 1916.*

I am instructed by the Director General of Public Health to acknowledge with thanks receipt of your letter of the 11th ultimo in regard to the destruction of flies by certain species of ants, and to say that the information furnished by you is greatly appreciated.

Your obedient servant,

MALITA, DAVAO, *May 30, 1916.*

Many thanks indeed for your letter of April 13, as it contained some information which will be of quite a little use to me. * * *

I am not in a position to give the time necessary to work out a paper pulp factory just at present but when I come to Manila during the latter part of the year I would like to call on you for all the information that you may have that will help me to utilize that small amount of waste that

¹ Translated from the Spanish.

occurs on a plantation the size of mine. I cannot afford to erect a large factory to handle what there is here but there should be enough stuff here to make 500 pounds of pulp a day, and that is what I want. * * *

Very sincerely,

PHILADELPHIA, *May 9, 1916.*

Many thanks for the lately received copy of your highly interesting and valuable Thirteenth Annual Report, which I have perused with lively attention and much pleasure and profit. The amount of routine work your Bureau has accomplished is amazing, without altogether neglecting more attractive research work. * * *

Heartily wishing you continued success in your enterprises, I am always,
Very truly yours,

MANILA, P. I., *19th April 1916.*

We beg to acknowledge the receipt of your communication of the 12th inst. and are very much obliged to you for the valuable information it contains concerning tanning barks.

We trust we shall soon have an opportunity to reciprocate, and remain,
Yours very truly,

MANILA, P. I., *April 13, 1916.*

Some months ago you were kind enough to send us your formula for rendering cloth bindings vermin-proof. This formula was sent on to our main office in Rochester, New York, with a view to replacing a formula which we had not found entirely satisfactory.

We are just in receipt of a letter from the Home Office advising that your formula has been treated and found satisfactory and that from this time on, they will discontinue the use of sheep in binding our reports and will use our regular buckram treated with your formula. Heretofore, we have been compelled to supply sheep bindings in districts where our buckram would not stand the ravages of the insects.

The Home Office states further that they are sending an advice to all our subscribers throughout the United States, their possessions and foreign countries, informing them of the change of binding and that it is due to the success of a formula perfected by the Bureau of Science of the Insular Government of the Philippines. Undoubtedly, this will be of interest to you.

With thanks for your great service, we remain,
Yours very truly,

POLO, BULACAN, *April 2, 1916.*

I have the honor to inform you that the result of the formula furnished free by that Bureau for bleaching to me has been successful. Allow me to express my sincere gratitude to you for this great favor. [Here follows the formula.] Those solutions are good for 100 hats.

Very respectfully,

COMPOSITOR DE SOMBREROS.

LA CARLOTA, NEGROS OCCIDENTAL, *March 29, 1916.*

I have the honor to advise you that Mr. J. E. Armstrong, sugar expert of your Bureau, has been performing very useful work in my "hacienda," where I have a modern mill equipped with vacuum pans, centrifugal pumps, etc. As the handling of these apparatus and the modern process of extracting sugar cane juice are new in this country, * * * during his

short stay he has demonstrated practical experiments which I believe will be of incalculable value to me in the future. * * *

Yours very respectfully,¹

MANILA, *March 21, 1916.*

In connection with our letter of July 12, 1912, requesting a compound for re-inking planotype ribbons and formula submitted in your letter of August 26, 1912, I wish to advise you of the results of this work.

One-quarter bottle of the solution was purchased at a cost of ₱5.88 which was sufficient for re-inking six of the ribbons. It will be noted therefore that the cost per ribbon is ₱0.96—slightly over 10 centavos per meter—for re-inking, exclusive of labor which is a negligible item in view of the fact that the messengers were employed for the work during otherwise spare time. New ribbons cost ₱2.63 each for the cheapest grade employed and ₱3.94 for a more expensive grade. The fabric, after being used thoroughly is not damaged and the re-inking has been done with success. The ribbons were finally dried after re-inking and are fully as satisfactory for ordinary use as are the original purchases.

This information may be of interest to you.

Very respectfully,

HONGKONG, *March 13, 1916.*

We beg to acknowledge receipt of your letter dated the 7th instant, contents of which are noted with thanks.

We have passed your information relative to Beriberi to our friends, whom we feel sure will appreciate the trouble you have taken so kindly in this matter.

We are, dear sir, yours faithfully,

MATABANG, TALISAY, OCCIDENTAL NEGROS, *March 3, 1916.*

Mr. Armstrong, of your Iloilo office, spent the day with me on my hacienda on his way to Isabela. He made several analyses of cane and sugar which benefited me and I am pleased to say that I appreciated his services.

I hope that you will allow him to come back again when convenient. We have several haciendas and need occasionally a look-over of a good practical man like Mr. Armstrong.

Thanking you, I am, yours truly,

BAGUIO, BENGUET, P. I., *February 26, 1916.*

We have a good deposit of silica that we should like to find a market for or a use for. * * *

You may be interested in knowing that the samples of hydrated lime you recently analyzed for us brought us a Manila order for 400 tons.

Thanking you for any information you may have re silica, we are,

Yours very truly,

MANILA, *February 25, 1916.*

We returned from Mindoro yesterday on the *Malecon*. I wish to thank you for the trouble you have gone to on my behalf, in helping me with my transportation difficulties. Had it not been for your timely assistance I would have experienced great trouble and delay in obtaining a steamer suitable for my work.

Please accept my appreciation of your policy of fostering the develop-

¹ Translated from the Spanish.

ment of the latent resources of the Islands. Kindly let me know what I owe the Bureau of Science over the credit which I now have with your department.

Yours very truly,

MANILA, *January 26, 1916.*

Allow me by these presents to tender you my sincerest thanks on behalf of "La Nacional Guano Factory," for the scientific services you have rendered us, through your valuable assistance of plant analysis, as received by us on the 18th inst.

Your tables are indeed interesting, and will help us materially in manufacturing a standard fertilizer suitable for these islands.

We are sir, very respectfully,

FAR EASTERN ASSOCIATION OF TROPICAL MEDICINE

The Fifth Biennial Congress of the Far Eastern Association of Tropical Medicine was to have been held in Java during the year, but the arrangements were canceled because of the European war.

PHILIPPINE ISLANDS MEDICAL ASSOCIATION

No meeting of the Philippine Islands Medical Association was held in 1916.

CONGRESS OF PHYSICIANS AND PHARMACISTS

The third congress of physicians and pharmacists was held in Manila under the auspices of the Colegio Medico-Farmaceutico of the Philippine Islands from the 7th to the 11th of February, 1916, inclusive. The congress was in every way a success, and employees of the Bureau of Science presented 17 papers on various subjects associated with or related to medicine or pharmacy.

STANDARDIZATION OF SUPPLIES

On March 28, 1916, His Excellency the Governor-General issued Executive Order No. 21, appointing "a permanent committee to be known as the Committee on Standardization of Supplies." The committee has held a number of meetings and, in accordance with the provisions of the Executive Order, has secured from Government officials reports and such other information as are essential to carry on its work. The available information is now being used to eliminate inferior material and to effect economy in the purchase of general supplies. The Bureau of Science is carrying on tests to classify many articles of wide variations, so that they may be purchased under specifications with the least cost. It will take a long time to standardize the thousands of articles needed by the Government. The war in Europe has interfered with many of our sources of

supply, and many conditions are abnormal. The work will be pushed as rapidly as possible.

MANUFACTURE OF TIQUI-TIQUI EXTRACT

Under the provisions of Act No. 2376 the Bureau of Science has continued its work of preparing extract of tiqui-tiqui for the treatment of infantile beriberi. A stock has been continually kept on hand, and that prepared up to the close of the year was probably sufficient to treat nearly 6,000 infants. The Liga Nacional Filipina para la Proteccion de la Primera Infancia submitted its report on October 15, 1916, from which I quote the following:

During this year the extract prepared by the Bureau of Science has kept in much better condition than that prepared during the preceding year. The organoleptic character of the extract and its keeping qualities could not have been improved. * * * From October 16, 1915, to October 15, 1916, 4,967 fifty cc. bottles of extract and 39 one cc. ampuls for hypodermic use have been obtained from the Bureau of Science, that is, 1,193 bottles more than that obtained last year. * * *

In the acute forms the mortality during this year has been only 85.7 per cent due to the injection of the extract, instead of 100 per cent as heretofore. * * *

Theoretically no children suffering from beriberi that are treated in time with a sufficient dose of extract of tiqui-tiqui should die. As a matter of fact, our mortality does not reach 1.5 per cent and even this small percentage of mortality is due to the fact that the little patients do not reach us until it is too late, almost at the dying stage, when the medicine has no time to exert its beneficial influence.

Nevertheless, if we review the statistics of the Philippine Health Service, it would be observed that in spite of our work the mortality among children under one year of age due to beriberi continues to be what it has always been, that is, its proportion compared with the total number of deaths of children in the city of Manila is not less than 35 per cent. * * *

This is probably due to the fact that the mothers do not call a doctor for the proper treatment of their beriberic children and, secondly, to the fact that the doctor either does not diagnose correctly or uses an extract which does not possess the qualities which our experience has sanctioned.¹

REORGANIZATION ACT No. 2666

An Act of the First Session of the Fourth Philippine Legislature to take effect on its approval to reorganize the Executive Departments of the Government of the Philippine Islands was approved on November 18, 1916. This Act transferred the Bureau of Science from the Department of the Interior. In part it reads as follows:

SEC. 7. *Bureaus and offices under the Department of Agriculture and Natural Resources.*—The Department of Agriculture and Natural Resources

¹ Translated from the Spanish.

shall have the direct executive control, direction, and supervision of the Bureau of Agriculture, the Bureau of Forestry, the Bureau of Lands, matters pertaining to colonies and plantations on public lands, the Bureau of Science, the Weather Bureau, and matters concerning hunting, fisheries, sponges, and other sea products, and such other as may hereafter be assigned to it by law.

NECESSITY FOR RESEARCH

Almost daily inquiries come to the Bureau of Science with regard to Philippine problems. We should keep studying the possible resources, the health and other problems of the Islands, be prepared in so far as possible for questions as they come up and have information on hand when it is needed. The wonderful possibilities of this country should be studied to avoid waste wherever possible. The value of a scientist is his ability to work out problems without misdirected effort, rather than his accumulation of facts. Experience in working with problems enables a man to attack them without a waste of time, and experience in the Philippine Islands enables him to adapt his investigations to tropical conditions. Economic work in practically all scientific lines is primarily dependent on technical investigations. It is not always easy to see the practical bearing of certain pieces of scientific investigation, yet it is surprising how often the seemingly useless and impractical will be found of vital importance. Pasteur's experiments to disprove the theory of spontaneous generation were not looked upon as of any practical value at the time they were undertaken, yet they are the basis of the modern practice of sterilization, and the noun "pasteurization" perpetuates the author's name. Geology, the study of rocks, may seem dry and useless, yet this study is necessary for the discovery and recovery of such useful substances as iron, gold, coal, and petroleum. Conditions in the Philippines are different from those in countries that are more highly developed economically. Work done in other countries is frequently not directly applicable here, and there are many problems to be solved that have not been considered elsewhere.

COMPENSATION OF SCIENTIFIC EMPLOYEES

The question of salaries of scientific employees is difficult to decide. Scientific positions should be filled by men of training and ability, and the supply of able men is limited. The material equipment of this institution is excellent, but material equipment without good men is of no avail. It is not equipment so much as the ability of the men that makes an institution. Medi-

ocre men can do certain classes of routine scientific work, but it requires capable men to apply their training to their problems. A well-trained man is able to work out the problems which are to be solved by experimentation. Able men must be retained. Mediocre men cannot do any real constructive work. A man must be well trained and feel himself a part of the institution in which he is employed to do his best work. Low-salaried positions are used only as stepping stones to something else. Scientific men who are satisfied with low-salaried positions are usually of mediocre ability, and a changing personnel is most expensive. Economic rocks, plants, insects, etc., must be accurately known before economic data can be made available. The geologist, botanist, entomologist, or other specialist having long experience in a country can in a very high percentage of cases answer a query offhand that a novice would not be able to answer at all, or only after many hours or even days of critical study. Only when an institution has a certain permanency of personnel can the work progress. The necessity for a permanency of personnel in the Philippine Islands is felt more than elsewhere because conditions are unique, and technologists frequently must serve an apprenticeship before they become of great value. A new man spends much of his time and energy during the first year or two in becoming adjusted to new conditions. The work of the Bureau of Science is so important that we should continue to attract and retain men of the highest ability. Our work is so complicated that we must retain a permanent nucleus, and to do this men must be contented and satisfied with their future outlook.

Scientific work requires long years of training. In addition to an ordinary education a scientist devotes from five to eight years to further study. During this period he draws no salary, and his expenses are large. On the other hand, during the same period a clerk, an internal revenue agent, or a customs inspector not only does not have to meet educational expenses, but draws a salary. In view of these facts, the salaries now paid to scientific employees are very low in comparison with those allowed clerks, mechanics, etc. Any reduction in salaries or a disinclination to make promotions will mean that competent men will soon find more lucrative positions elsewhere.

Unfortunately there are a great many lines of scientific work to which the Filipino youth is not attracted. There are other lines for which there are no training facilities provided in the Philippine Islands. The Filipino youths are attracted to the

exact sciences and to medicine more than to the lesser biological sciences. This is probably as it should be for some time to come, for in certain lines wholesale quantities of trained men are needed, and it is more likely that a man will fit where there are many opportunities from which to choose. It should be realized that the development of the Philippine Islands in competition with the world must more and more depend on competent scientists. The Philippine Islands have an advantage in having started right and in not having to waste their raw materials or jeopardize their natural resources by careless exploitation.

PUBLICITY

The inhabitants of these Islands are not getting as great benefit from the work which the Bureau of Science has done as they ought to be getting. In this institution there is unquestionably a great deal of information on many subjects that would benefit or improve agricultural, health, mining, industrial, commercial, and other economic conditions if brought before the people in the right way. The Bureau of Science has done and is doing work that is important to the Philippine Islands and has prepared, published, and circulated throughout the Islands reports and statistical information concerning its work that has aided and will continue to aid industrial and commercial development. The large amount of good done by these is becoming increasingly evident. However, a large percentage of the people who need assistance are unable to derive it solely from publications. To men not trained to use them, written regulations and directions often seem more or less impractical, but when such men actually see the work performed and the results accomplished, they are readily convinced of the importance of doing work scientifically. For example, many owners of salt farms are not trained to make use of literature put into their hands, but can readily learn from actual demonstration.

From the little that has been done to demonstrate the various lines of work of the Bureau of Science it has been found that the people are quick to see the value of such work and are sincerely appreciative of what it will do for them. If representatives from the Bureau of Science be sent among the people to demonstrate improved methods of procedure along such lines as the utilization of waste products, the development of mineral resources, the production of better leather, the utilization of forest products, the use of medicinal plants, the conservation and

increase of sea products, the relation of insects and birds to agriculture and to man and domestic animals, the better utilization of products such as sugar cane and the nipa palm, the adaptation of soils to crops, etc., and to introduce new and better industries of immediate and vital interest to the inhabitants of these Islands, it will be possible to bring about needed reforms and an improvement of their economic conditions much more rapidly. This has been done to a limited extent among the sugar growers of Negros. Their appreciation of this work and their desire for further help of this kind is conclusively shown in the letters included in this report.

With its limited personnel and the scientific staff overloaded with routine work, it is impossible for the Bureau of Science to devote time to the proper demonstration and explanation of the information that it has available. On the other hand, the Bureau of Science does want the people to understand and appreciate its work, for only through the people's confidence and sympathy can the Bureau best fulfill its functions. There is immediate need for a number of statisticians and demonstrators to place before the public the collected data and the results of experiments, to demonstrate new and improved methods, and to introduce new industries. It seems reasonable to suppose that the extra expense involved in this form of publicity would be amply justified.

BIOLOGICAL LABORATORY

Personnel.—Dr. J. A. Johnston was absent on leave from October 4, 1915, to April 1, 1916. Dr. H. W. Wade reported for duty February 2. Dr. O. Schöbl, who resigned while on leave, accepted reappointment and returned to duty on March 7. Dr. B. C. Crowell was transferred to the University of the Philippines, where he has been detailed for half time for several years. Dr. E. H. Ruediger was retired on April 25, since which time the section of sera and vaccines has been in charge of Doctor Schöbl. Doctor Panganiban, veterinarian, and Doctors Navarro, Monserrat, and Liboro, physicians, have been appointed and assigned to duty in the laboratory.

Routine.—After a period of quiescence during the first three months cholera again assumed noticeable proportions in April and continues up to December 31. The work of this laboratory has convincingly shown the continuance and spread of the disease to be due to "carriers." In this connection, in coöperation with the Philippine Health Service, a systematic examination

of all those connected with the handling of food has been carried out.

In addition to the large number of faecal specimens for cholera, routine examinations of water, milk, blood, sputum, plague, leprosy, gonococci, urine, foodstuffs, etc., have been performed.

Sanitary Health Commissions.—The Bureau of Science has continued the supervision of the bacteriological work of the Sanitary Health Commissions. This institution does not have sufficient personnel to do all of the bacteriological work, but one assistant has been constantly detailed to provincial duty.

General.—Twice during the year the Bureau of Science has complied with a request of the Director of Health for an assistant bacteriologist to be detailed for provincial laboratory work to suppress severe local outbreaks of cholera. Owing to more intelligent coöperation on the part of subordinate health officials, in taking and forwarding laboratory specimens, the Bureau of Science has been able to detect a greater percentage of the positive cases of cholera and cholera carriers from the provinces than ever before. Further investigations of the cholera-carrier problem are being carried on. Studies in leprosy previously reported are still in progress. Since this is a disease of long incubation, observation must necessarily be continued over a period of years. In the routine examination of rats one case of chronic or resolvent plague was discovered. An extensive study of fungus and allied skin infections is now underway. The published articles are given under the Philippine Journal of Science, Section B, on page 41.

Laboratory for sera and vaccines.—By a rearrangement of space three workrooms have been added to the rooms formerly used as laboratories in connection with serum work. The arrangement makes it possible to prepare and sterilize small glassware, such as graduated cylinders, pipettes, beakers, test tubes, Petri dishes, etc., without interference with the main sterilizing plant, which is taxed to its maximum by the work in connection with cholera examinations and general bacteriological work. Large pieces of glassware and apparatus used for bleeding, filtering, and filling of biological products are being prepared and sterilized in an autoclave located in front of the serum and bottling rooms.

The manufacture of these biologic products has been facilitated by the addition of three assistants, two of whom are medical

men and the other a veterinarian, and also by the detailing of a junior officer of the United States Public Health Service for part-time duty. They have been engaged in performing the daily routine work, such as Wassermann test, preparation of stock autogenous bacterial vaccine, preparation of antirabic vaccine, administration of Pasteur treatment, immunization and bleeding of horses for serum, and preparation of smallpox vaccine. The work accomplished is indicated by the following table:

Sera and vaccines bottled and disposed of at the Bureau of Science from January 1 to December 31, 1916.

Article.	Bottled.	Disposed of.
Antitetanic serum units	297,000	2,298,700
Antidiphtheritic serum do	121,000	90,000
Antidysenteric serum cc	1,620	5,122
Antistreptococcus serum do	240	1,830
Antimeningococcic serum do		3,370
Anti plague serum do		1,020
Anticholera serum do	39	24
Antityphoid serum do	3,859	41
Normal horse serum do	30,470	37,460
Typhoid vaccine ampuls	860	977
Typhoid and paratyphoid A & B vaccine do	442	109
Dysentery vaccine do	132	73
Cholera vaccine do	2,685	2,120
B. coli vaccine do	312	116
Streptococcus vaccine do	175	51
Plague prophylactic cc		3,330
Glycerinated plague vaccine ampuls		703
Cholera prophylactic cc		8,966
Gonococcus vaccine ampuls	2,164	2,140
Staphylococcus albus aureus vaccine do	249	672
Staphylococcus aureus vaccine do	120	3
Streptococcus-Staphylococcus aureus albus vaccine do	120	12
Autogenous vaccine do	470	470
Anthrax vaccine No. 1 cc		1,879
Anthrax vaccine No. 2 do		1,780
Staphylococcus albus vaccine ampuls	405	123
Rabies vaccine (a)	(a)	(a)
Tuberculin (human) cc	71	211
Tuberculin (bovine) do	50	96
Vaccine virus doses	1,744,770	1,569,014
Mallein do	540	971
Antisheep hæmolytic amboceptor units		3,000

^a The Pasteur treatment for rabies is now much more appreciated than formerly as shown by the following record of treatments:

Number of patients who received treatment at the Bureau of Science.....	94
Number of treatments sent by the Bureau of Science to outpatients.....	119
Total	213

SECTION OF BOTANY

Personnel.—The technical force remains the same as for the past year, with the addition of Dr. Leon Ma. Guerrero, who was appointed early in the year for the purpose of undertaking a survey of the medicinal plants of the Archipelago. Chief botanist E. D. Merrill was on leave of absence in the United States from April 5, 1915, to January 3, 1916. The relations of Mr. E. D. Merrill and Dr. W. H. Brown with the University are the same as during 1915, the services of the former being shared by the Bureau of Science with the University on an equal basis, and the latter, primarily employed by the University, being detailed to the Bureau of Science for certain work. By this arrangement Mr. Merrill has continued as head of the botanical department of the University, and at the same time both gentlemen have opportunity to do much technical research work.

The time utilized for the University is to a large degree offset by delegating much routine work to clerical employees who have been trained in certain lines, so the botanical output of the Bureau of Science has not been greatly restricted.

Exploration.—Messrs. Fenix, Ramos, and Edaño have successfully carried on field work in the following regions: Northern Samar; Bukidnon, Mindanao; and Nueva Ecija and Tayabas Provinces, Luzon. Smaller collections have been made in Laguna, Cavite, Rizal, Zambales, La Union, Ilocos Norte, Ilocos Sur, and other provinces. Dr. H. S. Yates made one extensive trip in Mountain Province and a shorter one in southern Tayabas, for the purpose of collecting fungi. Doctors Yates and Brown and Mr. Merrill have made an examination of the revegetation of Taal Volcano. Mr. Merrill spent three weeks' vacation in Kwangtung Province, China, in collecting and preparing botanical material.

One extensive trip of Mr. Fenix was devoted wholly to the investigations of the bast-fiber plants and bast-rope industry in the Ilocano provinces, Luzon. He collected botanical material and fiber specimens from all the plants utilized by the Filipinos in making rope and secured several hundred meters of each kind of rope, which are to be tested for strength, durability, etc.

Mycology.—When Doctor Yates arrived last year he found the mycological collections in a chaotic condition and has devoted much time to the arrangement of the material already identified. This phase of the work is now completed. He has carried on work in connection with the outbreak of bud rot in the coconut

region of Laguna and on the citrus canker in Mountain Province and has devoted much time to a study of the molds affecting copra. Field investigation has been made, and some inoculation experiments have been performed in a study of the cause of coconut bud rot.

Physiology.—The field work on the relation of environment to physical types of vegetation at different altitudes on Mount Maquiling was completed in 1915. Doctor Brown has made much progress in the task now in hand of correlating and interpreting nearly three years of field data, and this large work should be completed during the coming year. During this year he has initiated and nearly completed a series of field observations on Mount Banajao, with a view to complete a similar piece of work in relation to the vegetation of Mount Banajao, for purposes of comparison with that of Mount Maquiling.

In coöperation with Mr. G. W. Heise, of the division of inorganic chemistry, he has prepared for publication an article on the relation of light intensity to carbon dioxide assimilation and has planned a series of experiments for a further investigation of the problem. In coöperation with Mr. A. S. Argüelles he has in preparation a paper on the relation of soils to vegetation on Mount Maquiling. With Doctor Yates he has done the necessary field work and is now writing up the results in relation to the revegetation of Taal Volcano since the eruption of 1911.

Morphology of the volvocales.—This work has been carried on during the past year in the botanical laboratory of the Bureau of Science by Dr. W. R. Shaw, of the University of the Philippines. The project is now well advanced, and the results promise to be of great interest. Doctor Shaw has developed improved methods for collecting, preserving, staining, mounting, and photographing these minute organisms, and in the course of his work he has discovered several new generic types and undescribed species.

Medicinal plant survey.—This work was initiated early in the year, and its progress has been satisfactory. An effort is being made to compile all data of interest regarding medicinal, reputed medicinal, and poisonous plants of the Philippines; to identify the plants; and to select for chemical, pharmaceutical, and medicinal investigation those species of promise.

Systematic investigations.—Several thousand specimens that accumulated during Mr. Merrill's absence have been identified. Current collections made by employees of the Bureaus of Science and Forestry and by various private individuals have been also named and reported. General work on the Philippine flora has

progressed satisfactorily. Mr. Merrill has completed a study of the Robinson Amboina collections, and his very exhaustive and critical paper entitled *An Interpretation of Rumphius's Herbarium Amboinense* is in the hands of the printer.

The revision of all the Philippine species described by Blanco and by Llanos has been completed. Work on this project has been in progress for the past four years.

The herbarium.—The growth of the herbarium has been satisfactory in spite of the fact that the European war has reduced exchanges to a minimum. A general rearrangement of the material is in progress, with the object of making specimens from special regions more easily available.

Philippine accessions.—Specimens have been received by collection, gift, for identification, and by transmission from other branches of the Government. The collections of Philippine material are:

Collections of the employees of the Bureau of Science....	2,512
Collections of the employees of the Bureau of Forestry..	2,991
Miscellaneous collections of Messrs. C. F. Baker, H. Sandkuhl, C. A. Wenzel, N. Teodoro, M. Sablaya, C. M. Weber, R. Lete, P. J. Wester, and Mrs. Clemens....	2,141
Total specimens	7,644

Foreign accessions.—The foreign accessions are as follows:

Mrs. Clemens, Kinabalu expedition, Borneo.....	1,839
Mr. Topping, Kinabalu ferns.....	560
Miscellaneous fungi from the U. S. Department of Agriculture, exchange	708
Miscellaneous Malayan duplicates from the Botanic Garden, Buitenzorg, exchange.....	152
Miscellaneous duplicates from the Botanic Garden, Singapore, exchange	194
Bornean collections of Messrs. F. W. Foxworthy and A. Villamil	286
Guam plants, collected by A. Guerrero.....	88
Kinabalu collections of G. A. G. Haslam.....	101
Kwangtung collections of E. D. Merrill.....	601
Western Australian plants, ex herb. A. Morison from Edinburgh Botanic Garden, exchange.....	1,831
Total specimens.....	6,594

The total accessions for the year are 14,238 specimens, which have been poisoned, mounted, and so distributed as to be available to all who have occasion to consult them. The number of specimens in the herbarium now totals 172,518, of which about 73,000 are extra-Philippine.

Noteworthy in the extra-Philippine collections enumerated above are specimens from western Australia and from Borneo. Through coöperation with the forestry service of British North Borneo, arrangements have been made to have additional material collected, which will eventually place us in a position to do some valuable work on the Bornean flora in relation to that of the Philippines. During his vacation Mr. Merrill visited Canton, China, and collected 600 numbers, represented by about 3,000 specimens. His visit resulted in the establishment of field work in botany by the Canton Christian College, and through an arrangement with them we hope to receive valuable collections of plants from southern China.

Distribution of duplicates.—On account of the unsafe conditions of transit brought about by the European war, no large distribution of duplicates has been made. However, about 3,800 duplicates have been sent out on our exchange lists, and 2,300 specimens have been sent for purposes of identification. Eighteen hundred duplicates have been mounted and delivered to the Bureau of Forestry for distribution to the various forestry stations in the Philippines. About 700 mounted specimens have been loaned to specialists.

Publications.—In addition to the publications referred to above, a list of papers that have been published in Section C, Botany, of the Philippine Journal of Science, is given on page 42.

SECTION OF FISHERIES

Personnel.—Mr. Alvin Seale was retired from the Philippine service on July 16, 1916, and was succeeded by Mr. Edward H. Taylor, who began his duties in October.

The demand for window shell in other countries for the manufacture of lantern shades, screens, etc., in addition to the local use for windows, has so increased that there is danger of exceeding the supply. In the early part of the year the Bureau of Science undertook the planting of a new bed of these shells. Five thousand live shells were taken in Kawit and planted on the mud bottom of the esteros and oyster beds at Malabon. I believe these will thrive, if they are not removed by the local fishermen.

During the early part of the year a study was made of the operations of various sponge-fishing companies at Siasi and Tawitawi. One lot of sponges was confiscated because they had been taken contrary to law. The acts drafted in the Bureau of Science regulating the fishing for shells of marine mollusks in waters

of the Philippine Islands and regulating the sponge fisheries in the Philippine Islands were passed by the Philippine Legislature in February.

A study has been continued of various other sea products that have commercial possibilities, among which are trepang, tortoise shell, trochus and other button shells, pearls and pearl shell, shark fins, sardines, dried fish, edible sea weed, isinglass, crocodile skins, etc.

Mr. Taylor has taken hold of his new work with energy. An investigation of the ipon fisheries in Abra River was begun during the latter part of the year. The catch of this river amounts to a quarter of a million pesos annually, the tax on nets alone being nearly ₱3,000 for the two municipalities at the mouth of the river.

Black bass.—The black bass have bred well at Baguio, and large numbers are in the breeding pond awaiting distribution. A successful transfer of small fry was made from Baguio to Manila. Thence one lot was transferred to Sampaloc Lake in Laguna and a second and larger lot to Lanao Lake in Mindanao. The possibility of breeding black bass in Manila is being studied. Heretofore the bass have not bred in Manila, and the Bureau of Science fish pond is being deepened as an experiment.

Mosquito fish.—The Bureau of Science has distributed more than 10,000 mosquito fish throughout the Islands to those who have applied. There is still stock ready for distribution.

Aquarium.—Several new collections of fish have been made during the year at Calapan. These have been added to the collection at the Aquarium. Two new species of turtles have been added to the collection. A dugon brought from Albay succumbed after a month's captivity. The mortality among the fish has been as low as could be expected. There are at present in the collection 699 specimens representing 165 species.

Records.—All the known sponge beds were mapped by Mr. Seale during the early part of the year. The publications from this section are included under Philippine Journal of Science, Section D, on page 42.

SECTION OF ORNITHOLOGY AND TAXIDERMY

The scientific personnel remains unchanged. The important work of the study of the food habits of birds, in order to determine their economic relation to agriculture and to forestry and their possible rôle in the control of disease-bearing insects, has been continued. This work is slow, especially when little as-

sistance is available, and accurate results can be obtained only by the examination of hundreds of bird stomachs collected throughout the year. Several hundred stomachs have been examined, and the results have been recorded for future use. Additional material is on hand awaiting examination.

Many of the blank forms, which were distributed with the leaflet entitled Food and Habits of Philippine Birds, have been returned to the Bureau with a large quantity of information. This material will be issued in popular form as soon as it can be properly prepared.

A little has been done on the classification of specimens when time was available. One short paper, New or Noteworthy Philippine Birds, I, was published in the Philippine Journal of Science.

The taxidermist has preserved specimens of birds and snake skins and has mounted several heads and horns of the wild carabao and of the timarao. The latter animal is found only on Mindoro Island and is of much scientific interest. It is said that the timarao resembles the anoa, of Celebes. Because of the increase in taxidermic work an assistant to the taxidermist has been employed.

SECTION OF ENTOMOLOGY

This institution continues without the services of an entomologist, as no appropriation has been made for this important work, although specialists in this line are very much needed. The rearing of silkworms has been continued under the supervision of the ornithologist without change. There are frequent requests for eggs and for information in regard to the cultivation of mulberry plants and as to the commercial possibilities of silk culture in the Islands. As an aid to those wishing to establish mulberry plants, press bulletin 55, in English and in Spanish, was distributed in September.

An attempt was made to import the eri silkworm from Ceylon, but unfortunately the cocoons were sent to us by way of England and were worthless when received. A small area in Malate Park has been planted, partly with mulberry and partly with castor plants. The leaves of the latter will be used to feed eri worms if they are later introduced.

The rearing of silkworms seems in many ways adapted to this country and to its people, but for the development of the industry the Government should employ an expert sericulturist. Silk, like other animal and plant products, to be of good quality must

be the product of selected stock and skillful rearing. To gain and retain a good name for Philippine silk, a silk expert is needed. To develop the industry there should be demonstrators, trained by the expert, who will establish small silkhouses where the people can be shown the possibilities of this industry.

CHEMICAL LABORATORY

DIVISION OF GENERAL, INORGANIC, AND PHYSICAL CHEMISTRY

The plan which I inaugurated last year of operating the division of general, inorganic, and physical chemistry under three superintendents of section who would report directly to me has been entirely satisfactory. The sections continue to be designated (1) Section of analytical chemistry: Rocks, minerals, ores, slags, clays, limes; plasters, soils, fertilizers, etc.; iron and steel; metals and alloys; pigments and mixed paints, including vehicles; fuels, including calorific value; gas; inorganic chemicals and other inorganic analyses, except fire assays. (2) Section of weights, measures, water analysis, and physical chemistry: Waters, sewage, corrosion; weights and measures; instruments and apparatus such as thermometers, pyrometers, microscopes, refractometers, and other physical and chemical apparatus. (3) Section of physical and mechanical testing: Cements, aggregates; iron and steel; road materials; tar, asphalt, and bitumen; stone, twine, ropes, wires, khaki cloths, fuels, etc.; and the standardization of other classes of supplies.

The personnel of the sections remains unchanged, except that in the section of weights, measures, water analysis, and physical chemistry, to fill a vacancy which has existed since January, Mr. A. S. Behrman was transferred from the Bureau of Education on June 1, 1916, and was trained especially for the field work in water analysis. Mr. V. Q. Gana resigned, effective May 9, 1916. Mr. J. Gonzales, who has served as a temporary employee, was assigned to routine work in the water laboratory. He qualified on November 6, 1916, for regular appointment in the classified service. Mr. F. M. Villanueva has been employed since November 9, 1916, in the section of physical and mechanical testing, where he is at present engaged in an investigation of the manufacture of roofing tiles. There has been the closest coöperation between the sections, men have been transferred temporarily from one section to another, and there has been no confusion, overlapping, or neglect of work.

Routine.—The routine work accomplished by the division of general, inorganic, and physical chemistry has been as great as,

or greater in variety than, in former years, and the amount is shown in the following general summary:

Nature of material.	1915	1916
Metals and alloys	44	19
Rocks and minerals	15	95
Natural pigments and varnishes		20
Clays, shales, limestone, limes, wall plasters, cements, and slags	5	10
Fertilizers	34	72
Soils and similar substances	365	18
Coal analyses	50	10
Calorimetric tests of fuels	34	7
Waters	201	161
Crude inorganic chemicals (preparation and analysis) and miscellaneous analyses	135	161
Standard solutions	20	304
Examination for sea-water damage	(a)	58
Physical tests of wire, twine, fiber, textile, paper, steel, tar, asphalt, etc	32	4
Cements	6,716	15,909
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, wood, iron, steel, etc	203	468
Standardization of road materials	71	67
Standardization of unites of measures:		
Lengths	60	679
Capacities	121	56
Weights	31	20
Miscellaneous	22	19

^a Included under "Miscellaneous analyses."

The number of samples of water analyzed shows a slight decrease from the preceding year, owing partly to the greatly increased volume of field water work and partly to the decrease in well-drilling operations by the Bureau of Public Works.

In the preceding table many of the results represent more than ordinary routine work, for frequently members of the various sections have been called upon to pass judgment on the quality and the commercial value of the samples submitted for analysis. In several instances additional experiments were necessary to solve various problems of commercial importance. Considering the fact that in many cases, for example, examination for sea-water damage, the sample may represent many thousands of pesos, it is evident that the greatest care and precision is necessary in all of this work.

All the apparatus being used are standardized and checked, and precautions are taken to maintain the highest standard of work. During this year the output of each cement briquette maker has been studied, and those who cannot uniformly maintain a certain standard are eliminated or transferred to other

classes of work and their places filled by those having the required ability. With the object of encouraging briquette molders to put forth their best efforts, a bonus system has been devised. Although received irregularly, the number of cements tested has been greater than during any former year. Not only has there been a large number of requests at one time for cement tests, but also requests asking that certain samples be rushed. In order to complete all of the work without delay, the laboratory has been arranged so that at any time the output can be temporarily doubled by detailing some of the regular shifts to night duty and filling the gaps with new recruits.

INVESTIGATION

In this division, as in the other branches of the Bureau of Science, a scientific study of Philippine problems is indispensable and men can be of the greatest value only when they devote considerable time to careful study. This study is guided along the lines of Philippine industry.

The present European war has brought about a shortage of, and an increase in, the price of sodium peroxide, the chief chemical used for bleaching native hats. In order to remedy this shortage and to make bleaching agents available, the Bureau of Science has carried on a number of experiments with a view to find other chemicals obtainable in the local market at a reasonable price that would serve equally well. The results of these experiments show that sodium hypochlorite is adapted for bleaching native hats and can very well replace sodium peroxide. It is now being used by some hat factories for this purpose. Sodium hypochlorite can be readily prepared from bleaching powder and sodium carbonate or by direct electrolysis of a solution of common salt. The preparation of sodium hypochlorite from bleaching powder and sodium carbonate has been found economically possible on account of the fact that these chemicals are available in the local market and can be readily secured from Japan or from the United States at reasonable prices. The preparation of sodium hypochlorite by direct electrolysis of salt brine requires an initial outlay, but in the long run is more economical than the other process. With either of these two processes a cheaper bleaching agent than sodium peroxide can be produced.

After several years of planning, we were able to keep a man for over six months of the year at field work in water analysis.

This has been the best year up to date for the field survey of Philippine water supplies. Almost 200 examinations of water were made at the source. Rizal, Laguna, Sorsogon, and Cebu Provinces were visited. Practically every place visited had specific problems for which we were able to suggest solutions. Several towns were considering municipal supply projects. In a number of cases the choice lay between two sources, and our representative was able to designate the more desirable. In one instance work had been begun with the intention of using water of doubtful character.

In addition to the field water work we are endeavoring to classify all of the water data on hand with a view to eliminate obsolete data, secure the exact location of the sources of the various waters analyzed, and make available our present knowledge of Philippine waters. We have continued our campaign of instruction in endeavoring to prevent samples being taken from new wells before they have been pumped long enough for the water to be representative. Generally the first water from a well is poorer than that taken after continued pumping, probably due to the leaching of soluble ingredients in the water stratum. Early samples are useless and may result in the condemnation of what might have been a good well. For example, a certain well yielded water containing no harmful ingredients but was so turbid and unpalatable that the inhabitants used water from a questionable source in its stead. Finally when water was desired for a municipal supply, on the recommendation of this institution, the abandoned well was subjected to a protracted pumping test, whereupon the water became clear and unobjectionable. It may be expensive to retain a well-drilling outfit long after a well is completed, especially when other sections are clamoring for wells, but it may be that the benefit in so doing outweighs the disadvantages and may prove less expensive in the long run. In the case cited a thorough pumping test when the well was first installed would not only have saved trouble and the expense of unnecessary travel and analyses, but what is more important would have made available almost a year sooner a badly needed source of water.

Owing to the unsatisfactory results achieved by the steam sterilization of demijohns used locally in connection with the sale of artesian water, new cleaning methods were devised by the Bureau of Science and successfully installed. These methods, which consist of thorough cleaning, sterilization with chloride

of lime, and rinsing, require a minimum amount of handling of the demijohns, are economical, and with adequate supervision, practically insure sterile containers. These methods are the most successful yet tried and are in use by several companies.

Information concerning several other phases of water investigation is being accumulated. Work on the analysis of Manila rain water shows that in the vicinity of Manila approximately 165 kilograms of salt fall annually with the rain on each hectare of ground. Work on the standardization of methods of analysis and in modifying and improving the existing methods is continually in progress. Some data has been accumulated on the changes undergone by water samples bottled under various conditions. Many of the best known Philippine "mineral" springs and baths have been examined for radioactivity. When completed, the results should materially contribute to our knowledge of Philippine water supplies and geology and should be of more than local interest. As the result of our examination, one company advertising its bottled water as "containing radium" has discontinued the offending advertising.

With the coöperation of the Bureau of Public Works a large test fence has been made, apparatus has been constructed and standardized, and iron plates for exposure tests have been pickled and are stored awaiting use. The methods of making paint films and of determining the drying power, tensile strength, elasticity, and porosity of films have been worked out. The work will proceed as soon as the paint materials are furnished by the Bureau of Public Works.

Work on lumbang oil with respect to its use alone or in mixtures with linseed oil for paint is in progress. The effect of various dryers has been also studied.

The new lime kiln was completed during the year, and a beginning of the study of the manufacture of lime from Philippine limestone in this experimental kiln has been made.

A large number of investigations on cement, clays, tie materials, and concrete, including a study of failures of concrete construction throughout the Islands, the behavior of concrete made from certain aggregates obtained locally, and the effect of various electrolytes on cement, are underway. In the assistance to the local tanning, in the investigation of galvanized iron, etc., as much has been accomplished as the pressure of more urgent work would permit. Coöperation with the section of botany is mentioned on page 24. There are many lines of

work that should receive careful study, which it is impossible to undertake because of lack of personnel.

Topics upon which articles have been published have not been incorporated in this discussion, but are included under the heading Philippine Journal of Science, Section A, on page 40.

DIVISION OF ORGANIC CHEMISTRY

Personnel.—Dr. H. C. Brill, who had been acting chief of the division of organic chemistry, was regularly appointed on January 1, 1916. In addition the personnel consisted of Messrs. Albert H. Wells, Leavitt W. Thurlow, Harrison O. Parker, Francisco Agcaoili, J. F. Armstrong, F. T. Rosado, and Hermenegildo Taguibao. Of these members Mr. Wells returned from leave in the United States on April 3, 1916; Mr. Thurlow spent the year at the Bureau of Science Sugar Laboratory in Iloilo except the periods from December 4, 1915, to January 8, 1916, and from August 17, 1916, to November 18, 1916, which were spent in Manila. Mr. Agcaoili was on leave from April 3, 1916, to June 10, 1916, and was absent because of illness from September 18, 1916, to October 12, 1916; Mr. Rosado was transferred from the Bureau of Public Works on September 2, 1916, and was detailed to Iloilo on December 16, 1916; Mr. Armstrong gave all his time to the work of the sugar laboratory at Iloilo; the other members of the staff have spent all their time in the laboratory in Manila.

ROUTINE WORK

Mr. Wells has been placed in direct charge of the routine work of the division and designated the representative of this institution on the Board of Food and Drug Inspection. The routine work of the division has remained of the same character as heretofore as shown by the appended table of work accomplished. The number of samples examined was 1,763, which is slightly more than in previous years except last year, when the campaign carried out against the use of saccharine in bakery products resulted in an augmentation of the number of samples of this product examined.

The extract of tiqui-tiqui for the Liga Nacional Filipina para la Proteccion de la Primera Infancia is still prepared by this division. Before the departure of Mr. R. R. Williams, who had personal charge of this work, considerable difficulty had been experienced in the sterilization of the preparation. The problem

nas been solved by the use of fractional sterilization, and I am gratified to say that the officers of the Liga Nacional Filipina para la Proteccion de la Primera Infancia have commended the Bureau of Science as shown elsewhere. On account of the largely increased demand for this extract by the Liga, little has been furnished to outside agencies. Dr. N. M. Saleeby had been securing regularly increasing quantities of the hydrolyzed extract, which he has used in his practice with gratifying result.

Iloilo Sugar Laboratory.—The work of the branch of the division of organic chemistry maintained at Iloilo deserves special mention. Messrs. Thurlow and Armstrong have been able to do a great deal of work toward an extensive and intensive survey of the sugar industry in Panay and Negros. The response of the planters to the advice and counsel of these members of the Bureau staff has been gratifying.

INVESTIGATION

The routine work of the division has occupied a large part of the time of the members, but the investigation of some new problems has been completed, and several others are well underway. The titles of the finished articles are given under Philippine Journal of Science and other publications on page 40. Papers on the following subjects are in manuscript form: *Pangium edule* and *Hydnocarpus alcalae*; alcohol from discard molasses in the Philippine Islands; the fermentation of Philippine cacao; the infusorial earth extract of hydrolyzed tiqui-tiqui in the treatment of beriberi chickens; chaulmoogra oil used in the treatment of leprosy; the vitamine content of some Philippine vegetables; the use of the Kjeldahl method in the determination of the nitrogen of cyclic compounds; destructive distillation of Philippine woods with temperature control; the aging of Philippine coco and nipa brandies in charred barrels; the medicinal plants of the Philippine Islands; several papers on various phases of the coconut and copra industry; etc. The work on the coconut industry will be continued. Investigation is in progress on the examination of various rices for vitamine content to determine an equitable basis for classification of degree of polishing; gardenia flower for perfume; nutrition experiments; hydrogenation of Philippine oils; etc. Permission was given to Dr. H. C. Brill to contribute a paper to *Tropical Life*, at the request of the editor, on *The Ferments of Some Tropical Fruits and Vegetables*, and to Mr. L. W. Thurlow to publish a paper on *The*

Sugar Industry in the Philippine Islands, in the Louisiana Planter.

DIVISION OF MINES

Personnel.—Mr. V. E. Lednicky was appointed chief of the division of mines effective July 1, 1916, to succeed Mr. Wallace E. Pratt, who had been on vacation since July 15, 1915, and who was granted retirement effective April 1, 1916, under the provisions of Act No. 2589. During the vacation of Mr. Pratt, Mr. Lednicky served as acting chief. Mr. John P. Goldsberry, petrologist and geologist, reported for duty in Manila January 18, 1916, and since that date has handled the assaying and artesian well sample examinations. The division of mines has been very seriously handicapped by the smallness of the staff during the year, but an attempt has been made to handle as much as possible of the routine work presented. We have not been able to do all of the field work requested. The interest shown in mining by the Government and others warrants a considerably increased geological personnel.

Routine.—About 300 mineral specimens were examined and 200 consultations were had with individuals seeking geological information. A total of 517 assays, 11 bullion smeltings, and 93 placer weighings have been performed. The new Heusser assay balance has given entire satisfaction and has increased the speed and accuracy of weighings. A few leaching and amalgamation tests were made. One hundred ninety artesian well strata cuttings received during the year, together with the samples left over from the former year, have been examined. The usual drafting necessary in the preparation of maps and drawings for publication in the Philippine Journal of Science and other Bureau of Science publications has been carried on. The large relief map of the Philippine Islands, which we made for the Bureau of Science exhibit in San Francisco, has been rebuilt and recolored, and the legend with regard to the key to geology and the principal mineral localities has been added to it.

Field work.—Although the time available for field work was very limited, a comparatively large amount of it was done. Mr. Lednicky spent about half of his time on travel order. Practically all of this was spent in examination work for which the Bureau of Science received expenses and pay. Information valuable to the Bureau of Science was gathered on all of these trips, and considerable help was given the mining industry. During the year I issued the following travel orders for geological work:

Travel orders issued for geological work during the year 1916.

T. O. No.	Name.	Date of departure.	Destination.	Purpose of trip.
541	V. E. L., J. P. G.	Nov. 10, 1916	Mindanao	To examine the Cansuran Placer Co. property.
517	V. E. L.	Sept. 15, 1916	Aroroy, Masbate	To make a geological reconnaissance of a mining proposition.
516	V. E. L., J. P. G.	As soon as practicable.	Alabat Island and Polillo Island.	To collect information for the 1916 Mineral Resources and other geological information.
509	V. E. L.	On or about July 17, 1916.	Gumaus Placer Co.	To investigate data and conditions of the Gumaus Placer Co.
501	do	July 5, 1916	Batangas	To determine whether or not the Catholic cemetery is a public menace.
497	do	On or about June 27, 1916.	Laguna Province.	Inspection of the geology in the vicinity of spring in Laguna Province studied during the Bureau of Science water survey.
491	do	When convenient.	Bauyahan, Batangas.	To ascertain if limestone is available for rail shipment.
489	do	June 6, 1916	Baguio	To do confidential examination work.
463	do	As soon as the work in Pangasinan is completed (T. O. dated 3/6).	Mancayan copper region.	Geologic work.
462	do	Mar. 7, 1916	Pangasinan copper region.	Do.
458	do	On or about Feb. 29, 1916.	Zambales copper region.	Do.
452	do	Jan. 14, 1916	Mindoro	To do private professional geologic work.
455	J. P. G.	do	Sorsogon	To examine Bulusan Volcano.

Mining legislation.—The interest in legislation concerning mining continues, and it is hoped that a rational mining law will be put in operation in the Philippine Islands by the present legislature.

Publications.—It is our intention to issue the Mineral Resources of the Philippine Islands for a given year before March 1 of the year following. The issue for 1915 did not appear until late in the year due to numerous delays. The contents were as follows:

Staff, Division of Mines, Bureau of Science.

Philippine mining possibilities, by V. E. Lednicky.

Statistics of mineral production in the Philippines in 1915, by V. E. Lednicky.

Mining in the Philippine Islands, by V. E. Lednicky.

Philippine gold dredging, by Frank B. Ingersoll.

The iron industry in 1915, by V. E. Lednicky.

The salt industry of the Philippine Islands, by T. Dar Juan.

Philippine coals and their use, by F. R. Ycasiano.

The Acupan Mining Company, by V. E. Lednicky.

The papers that the scientists of this division have contributed to the Philippine Journal of Science are included in the list given on page 40.

PHILIPPINE MUSEUM

The portion of the museum exhibits sent to the Panama-Pacific International Exposition in San Francisco has been returned to Manila, and the whole exhibit has been segregated in the Sales Agency Building on the Luneta extension near the Manila Hotel, which was assigned to the Bureau of Science for this purpose. The arrangement of the exhibit in its new location is nearly completed.

LIBRARY

There have been no changes in the personnel of the library except of the temporary apprentices.

Routine.—Publications from all sources added since July 1, 1912, have been fully catalogued as received, and much progress has been made with the cataloguing of books received prior to that date. Practically all serial publications are now catalogued. The following table gives the record of technical work performed:

	Titles.	Volumes.	Parts.	Cards.
Classification and cataloguing	499	6,061	1,781	2,352
Reclassification and cataloguing	149	852	266	648
Total	648	6,913	2,047	3,000
Printed cards prepared and filed				5,220
Total number of cards filed in official catalogue				8,220

An inventory has been completed showing a remarkably small number of losses. The unbound material which has never been accessioned was counted during the year, showing 946 incomplete volumes, 3,024 complete volumes, 17,100 pamphlets, and 644 parts in the library. The accessions during the calendar year were 2,168 volumes, making a total number of 34,200 bound

volumes in the library on December 31. The usual number of exchanges and gifts have been received. Three thousand volumes for the Bureau of Science and 100 volumes for the Weather Bureau were prepared and sent for binding. No work has been done on cuts this year. One complete set of the Philippine Journal of Science was prepared, bound, and forwarded on loan to the New York branch office of the Philippine National Bank.

Union catalogue.—This is the best reference tool in the Philippine Islands, and it is our endeavor to keep it promptly up to date. The accumulation of Library of Congress proof slips on hand at the beginning of the year was filed, and the greater part of the proof received during the year was arranged in two alphabets and filed to "Braz."

Use.—The use has not varied materially from that of recent years, except that the number of scientific workers served by the library is even greater than formerly. The average daily circulation was over 46, and the average number of publications returned daily was 43. The question of "Reserved" books has been worked over during the year, and the resulting list of books reserved appears to be satisfactory.

Library training.—The work of the library science class of the College of Liberal Arts of the University of the Philippines was given by the librarian of the Bureau of Science in the Bureau of Science library from January 1 to the end of the college year and during the period from September to December. The class which entered in 1914 is now in the last semester of the third-year course; no other class has entered during that period. An examination to secure eligibles for a position of assistant librarian was given recently by the Bureau of Civil Service. The practical library questions were extremely non-technical, yet no one who had not worked in the training course passed. Of the 15 applicants, 6 passed, all of whom are at present members of the class or have had no less than two years of work in the course. Some work has been given to the fifth-year class of the College of Medicine and Surgery, with special emphasis on Government documents as sources of material in medical work, the supervision of manuscripts and bibliographies, etc.

THE PHILIPPINE JOURNAL OF SCIENCE AND OTHER PUBLICATIONS

During 1916 the Philippine Journal of Science was issued as usual in four sections, each of which contained six numbers. Each section is separately paged and indexed. The different sections contained the following:

	Section A.	Section B.	Section C.	Section D.
Pages	300	296	334	453
Plates	5	19	6	11
Text figures	13	22	-----	3

The numbers of the Philippine Journal of Science for Volume XI, 1916, contain the following articles. Names of members of the Bureau of Science staff are marked by asterisks (*).

SECTION A. CHEMICAL AND GEOLOGICAL SCIENCES AND THE INDUSTRIES

No. 1, January, 1916

- *Heise, George W. Notes on the water supply of the city of Iloilo.
- *Brill, Harvey C., and *Agcaoili, Francisco. Philippine beeswax.
- *King, Albert E. W. The pozzuolanic properties of Meycauayan volcanic tuff.
- *Heise, George W., and *Aguilar, R. H. The oxygen-consuming power of natural waters.

No. 2, March, 1916

- *Williams, Robert R. The chemistry of the vitamins.
- *Brill, Harvey C. Diethylsuccinosuccinate: II. A study of the absorption spectra of some derivatives.
- . *Hydnocarpus venenata* Gaertner: False chaulmoogra.
- . The salicylic acid reaction of beans.

No. 3, May, 1916

- *Agcaoili, Francisco. Some vegetables grown in the Philippine Islands.
- *Brill, Harvey C. Ipel, a coffee substitute: *Leucaena glauca* (Linnæus) Benth.
- *Heise, George W., and *Aguilar, R. H. The chemical purification of swimming pools.
- *Heise, George W. Note on the tidal variation of springs and deep wells in the Philippine Islands.
- *ThurLOW, L. W. Manufacture of lime in the Philippine Islands.

No. 4, July, 1916

- *Heise, George W., and *Clemente, Amando. The stripping and the analysis of galvanized iron.
- *Witt, J. C. The testing of galvanized iron.
- . Comments on the analysis of Babbitt metal.
- *Argüelles, Angel S. Galvanized-iron roofing in the Philippines.
- *Heise, George W., and *Clemente, Amando. The detinning and analysis of tin plate.

No. 5, September, 1916

- *Witt, J. C. Philippine paving-brick materials: A preliminary report.
- *Pratt, Wallace E. Philippine lakes.
- *Lednicky, V. E. The Palidan-slide mine.
- *Goldsberry, J. P. Eruption of Bulusan Volcano.

No. 6, November, 1916

- *Brill, Harvey C. *Datura alba*.
 - *Gana, Vicente Q. Some Philippine tanbarks.
 - *Wells, Albert H. Possibilities of gulaman dagat as a substitute for gelatin in food.
 - *Witt, J. C. The effect of sulphide on cement.
 - *Behrman, A. S. Note on the Blacher method for the determination of hardness in water.
- Reviews.

SECTION B. TROPICAL MEDICINE

No. 1, January, 1916

- *Ruediger, E. H. Preservation of human serum for Wassermann reaction.
- Mendoza-Guazon, Maria Paz. A case of infestation with *Dipylidium caninum*.
- *Ruediger, E. H. Haemolysis by human serum.
- De la Paz, Daniel, and Garcia, Faustino. An experimental study on the use of apomorphine to remove foreign bodies from the respiratory passages.

No. 2, March, 1916

- *Gabel, Charles E. Bacteriological examination of swimming pools in Manila.
 - *Ruediger, E. H. Wassermann reaction with glycerinated human serum.
- Reviews.

No. 3, May, 1916

- Ruth, Edward S. On the development of twins and other polyembryos with special reference to four sets of duck twins.
- Gibson, R. B., and Concepción, Isabelo. The influence of fresh and autoclaved cows' milk on the development of neuritis in animals.
- Concepción, Isabelo, and Bulatao, Emilio. Blood-pressure picture of the Filipinos.

No. 4, July, 1916

- *Schöbl, Otto. The relation between the amount of cholera culture injected into the gall bladder and the state of cholera carriers in experimental animals.
 - . The influence of bile upon the duration of the state of cholera carriers in experimental animals.
 - *Wade, H. Windsor. Carbohydrate fermentation by *Bacillus pestis*, comparing certain American and oriental strains, with analysis of discrepancies of fermentations with Hiss's serum water, litmus agar, and bouillon.
- Reviews.

No. 5, September, 1916

- Garcia, Arturo. Congenital bilateral absence of kidneys in a 140-millimeter pig embryo.
 - Guerrero, Luis E.; de la Paz, D.; and Guerrero, Alfredo L. Poisoning by *Illicium religiosum* Siebold.
 - Boynton, W. H. Rinderpest in swine.
- Reviews.

No. 6, November, 1916

- *Wade, H. Windsor. Cultivation of a pathogenic fungus which exhibits botryoid and leucocytelike parasitic forms.
Boynton, W. H., and Wharton, L. D. A fatal parasitic infestation.

SECTION C. BOTANY

No. 1, January, 1916

- *Merrill, E. D. New plants from Sorsogon Province, Luzon.
De Candolle, C. A new species of *Hydnocarpus*.
Copeland, E. B. Miscellaneous new ferns.
Copeland, E. B. The genus *Loxogramme*.

No. 2, March, 1916

- *Merrill, E. D. Notes on the flora of Borneo.

No. 3, May, 1916

- Van Alderwerelt Van Rosenburgh, C. R. W. K. The Amboina Pteridophyta collected by C. B. Robinson.
*Merrill E. D. New or interesting Philippine Vitaceae.

No. 4, July, 1916

- Copeland, Edwin Bingham. Natural selection and the dispersal of species.
———. Hawaiian ferns collected by J. F. Rock.
*Merrill, E. D. New plants from Samar.

No. 5, September, 1916

- De Candolle, C. Piperaceae Philippinenses novae vel nuper repertae.
Copeland, E. B. Growth phenomena of *Dioscorea*.
*Merrill, E. D. Reliquiae Robinsonianae.

No. 6, November, 1916

- *Merrill, E. D. Reliquiae Robinsonianae (concluded).

SECTION D. GENERAL BIOLOGY, ETHNOLOGY, AND ANTHROPOLOGY

No. 1, January, 1916

- Schultze, W. A catalogue of Philippine Coleoptera.

No. 2, March, 1916

- Schultze, W. A catalogue of Philippine Coleoptera (concluded).

No. 3, May, 1916

- Banks, Nathan. Neuropteroid insects of the Philippine Islands. (Caddice flies, bark lice, mayflies, and related orders.)
Fleutiaux, Ed. Elateridæ des îles Philippines, II. (New species of Philippine click beetles.)
*Seale, Alvin. Sea products of Mindanao and Sulu, I: Food fishes and sharks.

No. 4, July, 1916

- *Seale, Alvin. Sea products of Mindanao and Sulu, II: Pearls, pearl shells, and button shells.
 Bunker, Paul D. Nesting of the Philippine glossy starling.
 *McGregor, Richard C. New or noteworthy Philippine birds, I.
 Kieffer, J. J. Neuer Beitrag zur Kenntnis der philippinischen Cynipiden.
 ———. Beschreibung einer neuen Mymaride aus den Philippinen.
 Schultze, W. II. Beitrag zur coleopteren Fauna der Philippinen.

No. 5, September, 1916

- Cockerell, T. D. A. The ceratinid bees of the Philippine Islands.
 Muir, Frederick. A new Formosan Purohita (Delphacidae).
 Grouvelle, A. Nitidulidæ (Coléoptères) des îles Philippines récoltés par C. F. Baker, II.
 Kieffer, J. J. Evaniiden (Hymenoptera) der Philippinen.
 Schultze, W. III. Beitrag zur coleopteren Fauna der Philippinen.

No. 6, November, 1916

- Oshima, Masamitsu. A collection of termites from the Philippine Islands. (New species of white ants.)
 Muir, Frederick. Additions to the known Philippine Delphacidæ (Hemiptera).
 Fleutiaux, Ed. Melasidæ (Coléoptères des îles Philippines récoltés par C. F. Baker. (New species of beetles.)
 Kieffer, J. J. Beiträge zur Kenntnis der Gattung Loboscelidia Westwood (Hymenoptera). (New species of wasps.)
 Kieffer, J. J. Neue Stephanidæ (Hymenoptera) der Philippinen. (New species of Philippine wasps.)

The Mineral Resources of the Philippine Islands for 1915 was issued during the year, as were also publication No. 10, Studies in Philippine Diptera, II, by M. Bezzi, and press bulletin 50, the manufacture of 96-degree sugar by the use of open kettles (cauas) and the vacuum pan. A translation of the latter into the Spanish, entitled *Fabricación del azúcar de caña*, was also printed, and a Bontoc grammar by Father Vanoverbergh is in galley proof.

The press bulletins issued during the year are as follows:

- Press Bulletin No. 48. Importance of soil surveys and Bureau of Science methods of taking samples. (March 23, 1916.)
 Press Bulletin No. 49. The Bureau of Science indicates the value of industrial alcohol as motor fuel. (April 28, 1916.)
 Press Bulletin No. 50. The manufacture of 96-degree sugar by the use of open kettles (cauas) and the vacuum pan. (August, 1916. Issued in English and Spanish.)
 Press Bulletin No. 51. The melting and reboiling of muscavado sugar. (June 27, 1916. Issued in English and Spanish.)

- Press Bulletin No. 52. Philippine natural dyestuff materials. (June 16, 1916.)
- Press Bulletin No. 53. Philippine bamboo, fibers, and grasses as materials for paper and paper pulp. (August 30, 1916.)
- Press Bulletin No. 54. Some industrial possibilities in the Philippine Islands. Prepared on July 17, 1916, as a memorandum for the Hon. Rafael Palma by the Director of the Bureau of Science. (August, 1916. Issued in English and Spanish.)
- Press Bulletin No. 55. Planting and care of mulberry trees. (September 11, 1916. Issued in English and Spanish.)
- Press Bulletin No. 56. The detection of "carriers" and cholera control. (September, 1916. Issued in English and Spanish.)
- Press Bulletin No. 57. Sugar planters suffering from economic waste. (October 9, 1916. Issued in English and Spanish.)
- Press Bulletin No. 58. Suggestions to authors: The preparation of manuscript and proof reading for the Philippine Journal of Science and other Bureau of Science publications. (October, 1916.)
- Press Bulletin No. 59. Hacenderos show their interest in the erection of modern sugar centrals. (November 10, 1916.)
- Press Bulletin No. 60. Water analysis in the Philippines. (November, 1916.)
- Letter from Francisco Abelardo addressed to the Director of the Bureau of Science, dated September 2, 1916. (Issued with Bulletin 56.)
- Memorandum for the scientific staff of the Bureau of Science, by the Director of the Bureau of Science, dated November 1, 1916.

The ten-year index, begun last year, is now in galley proof. Owing to more urgent work in other lines, work on the index progressed slowly.

The blanks and labels required by the various divisions have been printed.

The mailing list of the Philippine Journal of Science for the past two years has been as follows:

	1915	1916
Paid subscriptions	320	328
Exchanges	470	477
Reviews	66	61
Free	49	48
Total mailing list	905	914

On account of the increased price of paper, etc., a few exchanges and reviews have been discontinued. Some difficulty has been experienced in perfecting and sending exchanges.

Before the advent of the present European war there was a close scientific affiliation between nations, practically a world science. This could be hardly expected to persist to the same

extent during the continuance of hostilities. However, even since the war began, individuals have done work for the Bureau of Science when they were on furlough from the firing line. The Bureau of Science has been particularly fortunate in being able to derive much aid from the world science program, and any interruption of it affects this institution, for less general work applicable to the Philippine Islands is carried on. It is gratifying that during these disturbed times the Philippine Journal of Science has been so fortunate as to have a slight increase in its paid subscription list.

POWER PLANT

There has been no change in the personnel or in the functions of the central power plant for the Philippine General Hospital, the Bureau of Science, and the College of Medicine and Surgery.

Costs.—The electric current generated and delivered at the switchboard is 240,701 kilowatt hours, at an average cost per kilowatt hour of ₱0.077, which is considerably less than for last year. This is due to the fact that the producer-gas plant and gas engine were operated almost continuously during the greater part of the year. During the last month the gas engine was operated for one week only, on account of the lack of suitable coal. Had it not been for this, the average cost per kilowatt hour would have been still lower. The total amount of steam generated in the boilers is 6,934,840 kilograms, at an average cost of ₱0.00303 per kilogram.

Mansfield gas-generating plant.—The total gas generated was nearly 750,000 cubic feet (21,098 cubic meters).

Shop.—The number of shop requests is shown by the following table:

Bureau of Science.....	313
All other sources.....	22
Total	335

These requests do not include the setting up of new apparatus, the transfer of installations, or the overhauling and repairing of engines, boilers, automobiles, motorcycles, etc.

CLERICAL DIVISION

Mr. A. E. Southard, chief clerk and business manager of the Philippine Journal of Science, was absent on leave in the United

States from February 16 to June 5. He was detailed to the Executive Bureau from June 16 to September 23 and was retired from the Philippine service on September 24. The duties of Mr. Southard during his absence were performed by the property officer, cashier, and disbursing officer. In order to do this a readjustment of the whole clerical division was necessary. The supervision of the aquarium, except the scientific collections, has continued under the office of the chief clerk. Mr. L. G. Thomas, stenographer and employee in charge of the filing section, resigned effective October 7 to accept a position in a local business house. Mrs. A. M. Seeley is handling the dictation that formerly was attended to by Mr. Thomas. There have been a number of changes and reassignments in the clerical personnel in an effort to acquire the greatest possible efficiency in work that is quite varied and has technical features. The retirement of Mr. Southard has made necessary the temporary assignment of Mr. F. R. Ycasiano, mechanical and testing engineer of this Bureau, to the position of acting chief clerk. I hope to make his assignment as short as possible, for there are other duties for which his services are very much needed.

The office of the Insular Auditor has made a great many changes in the accounting system during the past year. The present system seems to be a vast improvement over the old one and is being intelligently handled by the accounting office, but it appears to require more time of our employees than the former system. Mr. Martinez has had greater responsibility with property work, which he has handled satisfactorily. An additional property officer is very much needed in order that Mr. Martinez may have more available time for property inspection and care. The filing of back correspondence is progressing slowly and as well as could be expected. The current correspondence is filed in good shape.

The Bureau of Science has practically completed raising the low levels of its grounds by excavating the good earth and filling below with ashes from the power plant. My plan in this regard has saved the Government about ₱10,000 in filling charges, besides providing a place for depositing rubbish that otherwise would have had to be carted away.

The breeding of guinea pigs and rabbits has not been so successful as in former years, and it is now very difficult to secure an adequate local supply of rabbits. Arrangements are being made to import them from Japan at a reasonable price.

PHOTOGRAPHY

The record of the photographic work is as follows:

Negatives taken or developed.....	561
Lantern slides	282
Prints, 5 by 7 inches.....	4,629
Prints, 8 by 10 inches.....	582
Prints of various sizes.....	395
Enlargements	6
Transparencies, 8 by 10 inches.....	9
Films developed	rolls.... 14
Films taken and developed.....	feet.... 10,000

AQUARIUM

The aquarium of the Bureau of Science continues to be very much appreciated. It has been partially discussed under the heading Section of Fisheries. The aquarium is self-supporting, that is, enough admissions were paid during the year to reimburse the Government for its up-keep. In addition to these, there were 9,257 free admissions to students and teachers of the public schools. There is no question about the educative value of the aquarium, and besides, it affords pleasure and pastime to great numbers.

GARDEN DAY

The Bureau of Science has prepared for display on City of Manila Schools Garden Day, January 27, 1917, at the Tondo Intermediate School, films of industrial, commercial, and scenic subjects in the Philippine Islands. Three free tickets to the aquarium for use on Garden Day will be given to each student who has successfully cultivated a garden during the year.

PHILIPPINE CARNIVAL AND CENTRAL LUZON AGRICULTURAL FAIR

An industrial exhibit is being prepared by the Bureau of Science for display at the Philippine Carnival, February 3-11, 1917, and for the Central Luzon Agricultural Fair to be held in Muñoz, March 12-18, 1917. The films prepared for Garden Day will be also shown in Muñoz.

EXHIBIT AT THE NEW YORK OFFICE OF THE PHILIPPINE NATIONAL BANK

The exhibit prepared consists primarily of photographs and the following Philippine Bureau of Science charts dealing with industrial possibilities in the Archipelago:

PHILIPPINE BUREAU OF SCIENCE CHART 1

SUGARS

[See prints in photograph stand.]

Cane sugar.—Cane sugar is one of the most important products of the Philippine Islands. In 1916 the exportation of sugar from the Archipelago

was about 340,000,000 kilograms, valued at \$18,582,000 (₱37,164,000). Negros and Panay have an annual production of about 250,000,000 kilograms, worth about \$12,500,000 (₱25,000,000). Sugar cane is also grown on Mindoro and Luzon. The annual production is about 70,000,000 kilograms, valued at \$5,000,000 (₱10,000,000). From 20 to 35 per cent of the sucrose is lost in many mills through poor milling and improper methods of handling cane and juice. Opportunity for investment in modern central mills is afforded.

Nipa palm sugar.—The nipa palm, which grows in immense areas on tide lands in various parts of the Philippine Islands, is the source of about 10,000,000 proof gallons of alcohol per annum. It has been shown that nipa sap has a composition similar to that of the juice of the sugar cane and that it can be more profitably used for the production of sugar than for alcohol. There are large areas of nipa swamp that have never been developed.

Buri palm sugar.—Excellent sugar is made from the sap of the buri palm, but the product is absorbed by the local market.

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The nipa palm as a commercial source of sugar; consideration of the principal difficulties encountered in collecting and preserving nipa palm sap, Phil. Journ. Sci., Sec. A (1913), vol. 8, No. 6, 377–398.

The manufacture of sugar from the sap of the buri palm, Phil. Journ. Sci., Sec. A (1911), vol. 6, No. 3, 186–189.

PHILIPPINE BUREAU OF SCIENCE CHART 2

PHILIPPINE ALCOHOL AND BEVERAGES

[See prints in photograph stand.]

Alcohol.—Almost the entire insular production of alcohol—about 10,000,000 proof gallons per annum—is made from the sap of the nipa palm. This palm grows wild in tide-water swamps. There are large areas of nipa swamp land that have not been developed. The discard molasses from the cane-sugar mills annually amounts to about 7,000,000 gallons. This, if converted into alcohol, would produce 5,000,000 proof gallons.

Palm brandy.—Distilled spirits from the fermented sap of nipa and of coconut palms, stored for five years in charred casks, are named "Philippine coco palm brandy" and "Philippine nipa palm brandy." Analyses by the Bureau of Science show that these products conform to the requirements of good brandy.

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PHILIPPINE BUREAU OF SCIENCE CHART 3

COCONUTS

[See prints in photograph stand.]

More copra is exported from the Philippine Islands than from any other country. Copra and coconut oil to the value of \$13,900,000 (₱27,800,00) were exported in 1915. The Bureau of Science has shown that the use of the fumes from burning sulphur in the drying process will greatly improve the product. This process has several advantages over the usual methods of drying, namely:

The sulphur fumes prevent the growth of molds during the drying process and make an exceptionally white and uniform product.

There is no loss of oil during the process.

A greater weight of copra is obtained from a given number of nuts, for no oil is destroyed by growing organisms.

The keeping quality of the copra is improved.

The oil is practically colorless, is free from rancidity, and is pronounced equal to, or even better than, the best Cochin oil.

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PHILIPPINE BUREAU OF SCIENCE CHART 4

RESINS, TERPENES, PERFUMES, EDIBLE NUTS, AND VEGETABLE OILS OTHER THAN COCONUT OIL

[See prints in photograph stand.]

Resins and terpenes.—Elemi, balao, apitong, almaciga, and copal find application in the varnish industry and in the making of resin soaps.

Perfumes.—The essential oils of ylang-ylang, champaca, vetiver, lemon grass, orange, cinnamon, and ginger are used in the perfume industry, and several of them are used in the manufacture of nonalcoholic beverages and fruit flavors.

Edible nuts.—The pili nut is very rich in oil. It is very delicious and has a flavor similar to that of the Brazil nut.

Vegetable oils other than coconut oil.—Important vegetable oils, besides coconut oil, are produced in the Philippine Islands from the physic nut, peanut, and pili nut and from the seeds of lumbang, kapok, cato, cashew, castor bean, and cotton. Lumbang oil has good drying qualities and is used in the varnish and the linoleum trades. Other oils now little known may prove to be of commercial value.

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PHILIPPINE BUREAU OF SCIENCE CHART 5

COMMERCIAL PLANT PRODUCTS

[See prints in photograph stand.]

Coffee.—Coffee grows well in several parts of the Philippine Islands, and beans of excellent quality are produced, especially in the highlands of Luzon. Scientific cultivation is probably necessary to increase the output.

Cacao.—First-class cacao is grown to a limited extent in many localities, and the production could be readily increased to export proportions.

Papain.—Papaya gum of as great activity as the best on the market can be and has been produced in the Philippines.

Strychnine.—Strychnine can be extracted from the seeds of *Strychnos ignatii*, a plant indigenous to the Philippines.

Datura alba.—The leaves and the seeds of *Datura alba*, which grows wild in the Philippines, are valuable as an asthma remedy and for other medicinal purposes.

Starch.—Several species of Philippine plants yield a high percentage of starch. The most promising of these are cassava, or camoteng cahoy

(*Manihot utilissima* Poir.), and tapioca. Among other possible sources are arrowroot (*Maranta arundinacea* Linn.); sincamas (*Pachyrhizus erosus* Urban); Polynesian arrowroot (*Tacca pinnatifida* Forst.); yams (*Dioscorea*); seeds of *Cycas circinalis* Linn.; and the sugar palm (*Arenga saccharifera* Labill.).

Dye materials.—Natural vegetable dyes are used locally. The present production is of slight importance.

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PHILIPPINE BUREAU OF SCIENCE CHART 6

TANNING AND PAPER-PULP MATERIALS

[See prints in photograph stand.]

Tan bark.—The area of the mangrove swamps of the Philippine Islands is estimated to be 207,000 hectares (511,500 acres). The bark from the mangrove yields an excellent tanning material. Cutch, the evaporated water-extract of tan bark, is imported into the United States in large quantities. Bark from the better species of Philippine mangrove trees contains 30 per cent of tannin. A net profit of from \$25 (₱50) to \$30 (₱60) per ton can probably be made on tanning material derived from the mangrove swamps in the Philippine Islands. Firewood and the products of wood distillation could be made in connection with the cutch industry. The bark of Benguet pine and of palo maria can also be utilized as tanning materials. Forest regulations prevent the cutting of palo maria exclusively for its bark.

Paper pulp.—One of the bamboos, known as caña bojo, has been shown to be especially suitable for the making of paper pulp; it grows in sufficiently large and pure stands to make possible the commercial production of paper pulp. Abacá waste, cogon, talahib, rice straw, etc., are other materials from which the Bureau of Science has made strong paper pulp and which it should be possible to utilize commercially for the same purpose.

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PHILIPPINE BUREAU OF SCIENCE CHART 7

PORTLAND CEMENT, LIME, AND LIME PRODUCTS

[See prints in photograph stand.]

Portland cement.—Imports of Portland cement during recent years have had an average annual market value of about \$750,000 (₱1,500,00). The local consumption is certain to increase as the country progresses in financial and industrial importance. The Rizal Cement Company has a small plant at Binangonan. The Bureau of Science has made excellent Portland cement from several local raw materials. In Cebu desirable materials occur adjacent to undeveloped coal fields, the fuel from which is suitable for burning cement.

Lime.—Excellent coralline and crystalline limestone suitable for the manufacture of lime occur throughout the Archipelago, and experiments of the Bureau of Science show that superior lime may be produced from any of these. The lime heretofore produced is of inferior quality, and much of that used for sugar manufacture and for other chemical purposes has been imported. The increased production of sugar by modern methods has so augmented the demand for lime that there is now a need for the output of large kilns. The crude lime of local manufacture sells for as much as \$15 (₱30) per ton. This price is sufficient to ensure a handsome profit for good lime. Hydrated lime should find extensive use for road-building and for waterproofing concrete.

Lime products.—In connection with a lime kiln the operation of a bleaching-powder plant and a sand-lime brick plant appear attractive. The value of bleaching powder consumed in Manila alone amounts to \$12,500 (₱25,000) per annum. Conditions are favorable in the Philippines for the commercial manufacture of bricks, building blocks, tiles, slabs, and ornamental stones from sand and lime. The cost of manufacture is sufficiently low to enable them to compete with the other building materials.

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PHILIPPINE BUREAU OF SCIENCE CHART 8

PETROLEUM, GAS, COAL, AND ASPHALT

[See prints in photograph stand.]

Petroleum.—The petroleum beds of Bondoc Peninsula, Tayabas Province, Luzon, have been studied by the Bureau of Science and are believed to be worthy of exploration by drilling. Petroleum is known also in Cebu, Iloilo, Capiz, and Leyte Provinces and in Mindanao Island. The oil of Bondoc Peninsula has a paraffin base and is practically free from sulphur.

Gas.—Natural gas occurs with the petroleum and has been encountered also in artesian wells in Albay, Pampanga, and other provinces.

Coal.—Nearly \$1,500,000 (₱3,000,000) worth of coal was imported into the Philippine Islands in 1916. Almost every island in the Philippine Archipelago and a majority of the provinces are known to contain coal or lignite. The Bureau of Science has accumulated data concerning the quantity and the quality of the coal in the different fields. Estimates indicate 3,500,000 tons of black lignite and 1,000,000 tons of sub-bituminous coal, while the probable tonnage is: Black lignite, 26,500,000; sub-bituminous, 31,500,000; bituminous or semi-anthracite, 3,500,000. The largest annual (1909) production to date is 30,336 metric tons, valued at \$98,592 (₱197,184). Coking-coal occurs in Cebu Province, but the seams have not yet been proved economically important. With Philippine coal the Bureau of Science has been able to produce electric power by means of its 67-horsepower Otto suction producer-gas plant at \$0.0165 (₱0.033) per net kilowatt hour.

Asphalt.—Commercial quantities of asphaltic materials exist in Leyte, and some exploratory work has been done on the deposits. There is a great abundance of low-grade material from which high-grade asphalt could be extracted. Various outcrops and seepages of hydrocarbons, ranging from petroleum itself through viscous liquids and semisolids to hard coallike bitumens, are known, and a proper combination of the different materials could no doubt be made to fulfil almost any road conditions.

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Asphalt in Leyte, Bureau of Science press bulletins 42 and 44.

PHILIPPINE BUREAU OF SCIENCE CHART 9

GOLD, SILVER, LEAD, COPPER, AND IRON

[See prints in photograph stand.]

Gold.—The production of gold is steadily increasing. The output in 1916 was worth over \$1,650,000 (₱3,300,000).

Silver and lead.—Silver is found alloyed with gold in practically all of the gold deposits in the ratio of 1 part silver to 4 parts gold. Native silver has been reported. Silver is found associated with galena in Bulacan, Paracale, Marinduque, and Mindanao. A newly discovered 2-meter vein of comparatively pure galena has been recently opened in Marinduque and is said to be extensive.

Copper.—Copper deposits are known to exist in several provinces. The deposits at Mancayan, Mountain Province, Luzon, have been worked for years, and large amounts of high-grade ore have been taken out. According to reports of various examining engineers there are 500,000 tons of available ore, averaging 2.5 per cent. Other copper deposits have been found in Benguet, Pangasinan, Batangas, Mindoro, Masbate, Panay, and Mindanao. The deposit in Pangasinan is being explored at the present time.

Iron.—There are valuable deposits of iron ore in the Philippines, some of them exceedingly well located for an economic handling of the ore. A lack of proper smelting facilities has prevented their exploitation on a large scale, but many small iron castings are produced each year in native furnaces.

A deposit high-grade hematite ore is available in Ambos Camarines and in Bulacan. An unworked laterite iron-ore deposit in Surigao, Mindanao, has been examined by Bureau of Science engineers, who estimate it to contain over 500,000,000 metric tons of available ore averaging from 45 to 50 per cent iron. The deposit is located near a good harbor, and the ore could be loaded with steam shovels at a low cost. Other valuable deposits occur, but no detailed examination of them have been made.

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PHILIPPINE BUREAU OF SCIENCE CHART 10

MINOR MINERAL RESOURCES

[See prints in photograph stand.]

Asbestos.—Asbestiform minerals are widespread in the Philippines. They occur associated with serpentine, which has been found in Ilocos Norte, Bataan, Antique, and Albay Provinces, Luzon.

Manganese.—Manganese occurs as psilomelane, pyrolusite, and wad in Ilocos Norte, Pangasinan, Bulacan, Tarlac, and Masbate. Three thousand tons of manganese were mined in Ilocos Norte and shipped to Japan in 1916.

Guano and phosphates.—Bat guano occurs in caves in nearly every province. Much of this is valuable as a fertilizer, and it has been used to great advantage on sugar cane fields. The guano can be delivered to any plantation for a fraction of the cost of commercial fertilizers. One planter in the Silay district, Negros, increased his crop nearly 100 per cent by the use of guano. An area of leucite-tephrite, a potash-bearing rock, which may some time become a source of potash, has been discovered and mapped near Aroroy, Masbate, by the Bureau of Science. Apatite, a calcium phosphate, found in Ilocos Sur, may indicate a commercial source of phosphates.

Salt.—The salt manufactured in the Philippine Islands each year is valued at more than \$250,000 (₱500,000). Sea water evaporated by solar heat is the source of the larger part of this production, but in certain localities, notably north-central Luzon, brine from salt springs is utilized.

Other Philippine mineral resources are fire clay, abrasives, alum, artesian and mineral waters, gems, and gypsum.

REFERENCES

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Manganese deposits of the Philippine Islands, Mineral Resources P. I. for 1911 (1912), 42-47.

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The salt industry and resources of the Philippine Islands, Mineral Resources P. I. for 1911 (1912), 63-75; Merchants' Assoc. Rev. (1911), vol. 1, No. 10, 2-8.

The occurrence, composition, and radioactivity of the clays from Luzon, Phil. Journ. Sci., Sec. A (1908), vol. 3, No. 5, 377-389. Philippine pottery, Phil. Journ. Sci., Sec. A (1910), vol. 5, No. 2, 143-153. The non-metallic minerals, Mineral Resources P. I. for 1907-1912 (1908-1913). Water supplies in the Philippine Islands, Phil. Journ. Sci., Sec. A (1914), vol. 10, No. 4, 273-411. Miscellaneous non-metallic mineral products, Mineral Resources P. I. for 1909 (1910), 43-52.

PHILIPPINE BUREAU OF SCIENCE CHART 11

FISHES

[See prints in photograph stand.]

Market fishes.—Two thousand five-hundred dollars' (₱5,000) worth of fish are sold daily in the Manila markets. A large part of these is bañgos (*chanos chanos*), which is artificially propagated in large ponds in the vicinity of Manila. Philippine waters abound in excellent food and game fishes. During calm weather they are taken by fishermen in small craft. There are no trawlers operating.

Sardines.—Such fishes as sardines, anchovies, and herrings exist in the Philippine Islands in large numbers and constitute a potential source of wealth. Nearly all of those caught are consumed fresh or are poorly preserved with salt. When these fishes are properly canned, the product is equal to the best in the market. Great improvement could be made in the salting of other classes of fishes. There is an abundant local supply of salt. The opportunity for a sardine cannery seems promising.

Introduced fishes.—The small-mouthed black bass (*Micropterus salmoides*) has been successfully introduced from the United States and is established at several points in the Islands.

REFERENCES

A check-list of Philippine fishes, Bureau of Science publication No. 1. Philippine commercial fishes, Philippine Journal of Science, Sec. A (1908), vol. 3, No. 6, 513–531. New species of Philippine fishes, Phil. Journ. Sci., Sec. A (1909), vol. 4, No. 6, 491–543; Sec. D (1910), vol. 5, No. 2, 115–119. The successful transference of black bass into the Philippine Islands, with notes on the transportations of live fish long distances, Phil. Journ. Sci., Sec. D (1910), vol. 5, No. 3, 153–159. Miscellaneous marine products of the Philippine Islands, Phil. Journ. Sci., Sec. D (1911), vol. 6, No. 6, 283–320. Food fishes and sharks of Mindanao and Sulu, Phil. Journ. Sci., Sec. D (1916), vol. 11, No. 3, 235–243. Fishery resources of Mindanao and Sulu, Bureau of Science press bulletin 34.

PHILIPPINE BUREAU OF SCIENCE CHART 12

PRODUCTS FROM MARINE SHELLS

[See prints in photograph stand.]

Pearls.—The pearling industry is well established in the southern part of the Philippine Archipelago. Pearls valued at about \$500,000 (₱1,000,000) are exported from Zamboanga each year.

Pearl shells.—The annual catch of pearl shells is valued at approximately \$350,000 (₱700,000).

Button shells.—The top shell (*Trochus*) and the turban shell (*Turbo*) are gathered for the manufacture of buttons. They are used locally or exported.

Window shells.—Window shells are used locally in the place of window glass. They can be made into attractive screens and lamp shades.

REFERENCES

Pearls and pearl fisheries of the Philippine Islands, Philippine Journal of Science, Sec. D (1910), vol. 5, No. 2, 87–101. The pearl fishery of Ban-

tayan, Phil. Journ. Sci., Sec. D (1910), vol. 5, No. 3, 149-151. Pearl, pearl shells, and button shells of Mindanao and Sulu, Phil. Journ. Sci., Sec. D (1916), vol. 11, No. 4, 245-265.

Miscellaneous marine products of the Philippine Islands, Phil. Journ. Sci., Sec. D (1911), vol. 6, No. 6, 296-305.

PHILIPPINE BUREAU OF SCIENCE CHART 13

MINOR MARINE PRODUCTS

[See prints in photograph stand.]

Sponges.—There are several valuable varieties of sponges in Philippine waters. They should be cured only by experienced men.

Tortoise shell.—Most of the Philippine catch of tortoise shell is exported. A small amount is manufactured locally into small articles. The export in 1913 was valued at about \$18,000 (₱36,000).

Trepang.—The annual export of trepang is worth about \$65,000 (₱130,000). Methods of drying could be improved, and the industry could be increased.

Coral.—Small pieces of the precious red coral have been found in Philippine waters, and a blue coral occurs which might be made into jewelry. Many kinds of white coral are abundant.

Oysters.—Oysters of good quality grow readily in the many tidal streams about Manila. The industry could be greatly increased.

REFERENCES

Sponge and sponge fisheries of the Philippine Islands, Philippine Journal of Science, Sec. A (1909), vol. 4, No. 1, 57-65. Sponges of Mindanao and Sulu (in manuscript).

Philippine tortoise shell, Phil. Journ. Sci., Sec. D (1911), vol. 6, No. 6, 291-295.

Philippine trepang, Phil. Journ. Sci., Sec. D (1911), vol. 6, No. 6, 283-289.

Philippine shark fin, Phil. Journ. Sci., Sec. D (1911), vol. 6, No. 6, 289-291.

Philippine corals, Phil. Journ. Sci., Sec. D (1911), vol. 6, No. 6, 305-308.

PHILIPPINE BUREAU OF SCIENCE CHART 14

BUREAU OF SCIENCE AQUARIUM AND MAIN BUILDING

[See cards in large frame and prints in photograph stand.]

Bureau of Science aquarium.—The aquarium of the Bureau of Science is situated in Manila on Calle Gral. Luna within the bastion of Puerto Real of the old city wall. The building is a substantial one-story structure of reinforced concrete. It consists of a single corridor or tunnel, 85 meters long and 8 meters wide. There are twenty-seven exhibition tanks, each of which is faced with 1-inch plate glass. The tanks are lighted by skylights, and the backs of the tanks slope, so that there is no unlighted corner. Practically all of the light in the corridor comes through the tanks. Two large tanks outside of the corridor, each about 12 meters in diameter, afford accommodation for crocodiles, sharks, and turtles. In the Bureau of Science aquarium there is at all times an interesting display of brightly colored and curious fishes, sea anemones, crabs, sea urchins, star-fishes, and other sea animals found in the waters of the Philippine Islands.

Main building of the Bureau of Science.—The main building of the Bureau of Science was completed in 1905. A reinforced concrete wing was added in 1911. The building houses all Government laboratories and the Bureau of Science library, which is the scientific branch of the Philippine Library. The scientific library contains about 35,000 bound volumes and about 20,000 unbound volumes and pamphlets. Some of the activities of the Bureau of Science are: The testing of cements, road-metals, and other construction and commercial materials; the bacteriological, pathological, and diagnostic work in connection with the detection and the control of diseases of man and of domestic animals; the biological and chemical examination of artesian-well and other waters; the preparation and sale of serums and vaccines; the investigation of fungi and the diseases produced by them; in charge of the Government herbarium of Philippine and Far Eastern flora, the investigation of economically valuable plants, and other botanical work; the collection of fish and marine animals, the development of the sponge, shark fin, trepang, and other sea-products industries, and the stimulation of the food-fish industry; the collection of birds and other natural history specimens, a study of the relation of birds to the control of insect pests, and the performance of other, similar zoölogical work; in charge of the construction and equipment of all Government laboratories in the Philippine Islands and of the standardization of instruments of precision, of measure, and of solutions for the Philippine Government; analyses of mineral products, soils, fertilizers, minero-medicinal waters, etc.; analyses of coals; analyses under the Pure Food and Drugs Act; investigations into quality, composition, or properties of articles of food and drink, of gums, resins, drugs, herbs, oils, and other plant products; investigations into the mineral and engineering surveys of mines; the Iloilo sugar laboratory and investigations into the quality of, and the means of improving, Philippine sugars, and the encouragement of Philippine industries generally; special investigations needed by the Insular Government which may require laboratory facilities or scientific knowledge of a specialized character; etc.

Publications.—The results of the work and investigation of the Bureau of Science are made available in the following series of publications which represent the Bureau of Science before the world:

- The Philippine Journal of Science.
- The Mineral Resources of the Philippine Islands.
- Annual Report of the Director of the Bureau of Science.
- Bureau of Science publications (monographs).
- Bureau of Science press bulletins.

PHILIPPINE BUREAU OF SCIENCE CHART 15

BIRDS AND INSECTS AND THEIR PRODUCTS

[See prints in photograph stand.]

Birds.—There are about 750 species of birds known in the Philippine Islands. Among the important game birds may be mentioned: The jungle fowl, the peacock pheasant, rails, snipe, plovers, godwits, curlews, ducks, and many species of doves. The edible-nest swift is found throughout the Islands. The nests of this bird are collected and exported.

Bees.—Wild bees are plentiful in all of the wooded portions of the Philippines. There is a considerable local trade, excellent honey and wax being

collected by the crudest methods. Domesticated bees have been imported. Apiculture has not been developed, but could be carried on in connection with farming to the extent of excluding imported honey.

Silkworms.—The Bureau of Science has introduced silkworms into the Philippine Islands and has developed a hybrid which yearly has nine generations. Silkworms are not attacked by disease in the Philippines. Their food, the mulberry, grows most luxuriantly in all parts of the Islands and is free from pests. A hectare (2.47 acres) (of 1,100 trees) will feed about three million silkworms per annum, and leaves may be harvested at the end of two years after cuttings have been planted. There is an excellent market for all the silk that can be produced.

REFERENCES

A manual of Philippine birds, Bureau of Science publication No. 2. Birds in their economic relation to man through agriculture and forestry, Bureau of Science press bulletin 32. Birds in their economic relation to man, Bureau of Science press bulletin 32, revised.

A manual of Philippine silk culture, Bureau of Science publication No. 4. Planting and care of mulberry trees, Bureau of Science press bulletin 55.

PHILIPPINE BUREAU OF SCIENCE CHART 16

TOBACCO

[See prints in photograph stand.]

About one-quarter billion cigars worth \$5,000,000 (₱10,000,000), of which 5 per cent are exported to the United States, are manufactured in the Philippine Islands annually. About four and one-quarter billion cigarettes are manufactured annually. It has been demonstrated by the Bureau of Science that 100 per cent immunity from the cigarette beetle, which has caused Philippine cigars to be rejected in the European and American markets, can be assured, if the manufacturer will properly protect his stock of raw and prepared tobacco while in the factory.

REFERENCES

Problems in economic entomology in the Philippines, Philippine Journal of Science (1906), vol. 1, No. 10. The cigarette beetle (*Lasioderma serri-corne* Fabr.) in the Philippine Islands, Phil. Journ. Sci., Sec. D (1913), vol. 8, No. 1, 1-42.

The cigarette beetle as a destroyer of tobacco, Bureau of Science press bulletin 30. The molds of cigars and their prevention, Bureau of Science press bulletin 31.

PHILIPPINE BUREAU OF SCIENCE CHART 17

PHILIPPINE FIBERS AND TIE MATERIALS

[See prints in photograph stand.]

Abacá (Manila hemp).—Abacá is the most important fiber and export product of the Philippine Islands. In 1916 abacá comprised 40 per cent of the total exports and was about 140,000,000 kilograms valued at \$26,700,000 (₱53,400,000). The purchaser is now protected in the materials which he purchases due to Government supervision of grading.

Maguey.—Frequently maguey and other fibers are cheaper than abacá (Manila hemp) and are as satisfactory for many purposes. The export of

maguey from the Philippine Islands in 1916 was valued at over \$1,700,000 (₱3,400,000).

Buntal fiber and other hat materials.—The fiber extracted from the petioles of the buri palm is used for making the buntal hats, one of the best hats of the Philippine Islands marketed in the United States as Bankok hats. Fine hats made from bamboo fibers are marketed under the name of Batavia hats. The present method of extracting the buntal fiber is slow and expensive. The Bureau of Science has improved the method, with the result that the cost of extracting the fiber may be much reduced and should not only cheapen this hat of superior quality, but make possible the use of buntal fiber in other countries. Several fibers are used in the manufacture of high-grade hats, similar to the Panama hat. Hats made from buri palm leaves are cheaper and better than the cheap straw hats sold in the United States. Abacá affords an abundant supply of excellent raw material which is woven into women's hats.

Rattans.—The commercial rattans of the Philippine Islands are derived from the climbing palms. The many species in the Philippine Islands belong to three genera. Some of these are small, the canes being 1 centimeter or less in diameter, while others have a diameter of 5 centimeters. The stripped material of some species is very tough; it has great tensile strength, does not readily break in bending, and can be readily bleached. As soon as the material can be satisfactorily separated into definite grades and the differences which control the commercial product determined, there is no reason why a considerable export trade of Philippine materials should not be developed.

Bast fibers.—Bast fiber is a tough, fibrous layer between the wood and the bark, which is characteristic of certain families of plants, some of which are represented in the Philippine Islands by numerous species. Among these are various species of trees, known as "banot" (genus *Sterculia*) and "analao" (genera *Grewia* and *Columbia*), and certain small shrubs, known as "anabo" (genus *Abroma*). These bast fibers have an extensive local use as a substitute for abacá, and in some parts of the Islands, for example, the Ilocano provinces, the making of rope from bast fibers has a considerable commercial importance. Some of the bast-fiber ropes are superior in durability to abacá rope when much exposed to moisture.

Kapok.—Tree cotton, while of too short fiber to be of use as a textile material, is a superior filling for pillows and mattresses. The fibers are oily and, therefore, do not become easily water-soaked. For this reason kapok is a suitable filler for life-preservers.

Cotton.—True cotton is cultivated and made into various articles for local use.

Cloths.—Some of the above-enumerated fibers and especially the fiber of the pineapple are manufactured into cloth for which there is a certain export demand. Cloth known as piña made from the pineapple fiber is very similar to very fine linen and is used especially in making fine embroidery. Sinamay made from abacá is similar to crinoline and is used for similar purposes. The so-called Ilocano cloth made from cotton is characteristic on account of the weave and the dyeing and is much sought for and popular for curtains, pillow covers, etc.

REFERENCES

Philippine hats, Philippine Journal of Science, Sec. C (1911), vol. 6, No. 2, 93-131.

The charts are illustrated by well-arranged photographs mounted in a photograph stand. A complete file of the Philippine Journal of Science, Mineral Resources of the Philippine Islands, and various miscellaneous publications has been placed on file in the New York office of the Philippine National Bank.

RECOMMENDATIONS

During the past calendar year we have had available for the work of the Bureau of Science ₱371,976. This amount is too small to perform most efficiently the work which the Bureau of Science should do, and many constructive problems remain untouched. An increased appropriation, if judiciously handled, would yield more than proportional returns on the investment. Practically all of my recommendations for the last four years remain unacted upon. Because of lack of funds the legislature has made no appropriations for the extension of any work in the Bureau of Science. In the past only a very few legislators have shown a desire to ascertain how the Bureau of Science could become of greatest value to the Philippine Islands. With a permanent legislative body and an increased interest in the development of natural resources it is hoped that my recommendations of former years may receive careful consideration. The need for all classes of scientific work is increasing, and their value is being much more recognized and appreciated. The extension of publicity propaganda along all scientific lines is badly needed as indicated on page 19. In practically every branch of its activities the Bureau of Science needs more scientific employees to keep up with the regular work of the institution, to do the work requested, to be ready to supply desired information, and to answer questions when they arise.

The Bureau especially needs an entomologist. None is on duty at present, and the available position was abolished by the legislature. Also, as already pointed out under entomology, this institution should employ an expert sericulturist. The rearing of silkworms seems admirably adapted to this country, but there must be careful selection of stock, skillful rearing, and a good name developed for Philippine silk. For such work a silk expert is urgently needed.

Work on the Bureau of Science medicinal plant survey of the Philippines should be prosecuted vigorously, and this can be done most successfully only by close coöperation of the botanist, the organic chemist, the pharmaceutical chemist, and the physicians. The chemist at present assigned to this work can carry it on only when he is free from routine, whereas his major work

should be on the promising medicinal and poisonous plants that have not as yet been subjected to any investigation. The field here is almost unlimited, and a critical study is certain to yield much of interest and value.

The work of the sera and vaccines laboratory could be greatly facilitated by increased stable accommodations and a larger paddock. A modern operating room also should be provided. I believe there is opportunity for the commercialization of this work in the Philippine Islands if proper facilities are provided.

The field survey of Philippine water supplies described on pages 31 and 32 is a most important piece of work and should be greatly extended. Few countries are better adapted climatically for carrying on field work, and in few countries is such work more necessary or more capable of producing beneficial results. The present personnel is insufficient to do the work which should be done.

The herbarium collections are now housed in the fire-proof east wing of the Bureau of Science building and, from the standpoint of safety, are well protected. However, the present quarters are inadequate, involving much loss of time in consulting the collections, a difficulty that will increase rather than decrease. The preparation of adequate properly arranged quarters for this valuable botanical collection should be made. The constant addition of books to the library will necessitate additional space, which could be readily arranged for by the allotment of that now occupied by botany.

Almost every section of the Bureau has inadequate laboratory space, and chemists and others are working in crowded rooms. The quarters for the testing of structural and other materials, such as cement, reënforcing iron, steel, rope, wire, road materials, tiles, cement pipes, concrete, mortar, building blocks, bricks, stone, cloth, etc., are much too small. The city of Manila is most anxious that the Bureau of Science make the regular tests of the gas supplied by the Manila Gas Corporation under the municipal ordinance, but there is no space available for this purpose. There is no adequate protection for the consumer without such tests. The need for greater space could be met by the erection of a wing on the west end of the main building corresponding to the one on the east end.

I desire to renew my recommendation of last year that the Government aid in sending the more advanced Bureau of Science library assistants to the United States for further professional training, in order that we may have available a group of trained

employees for carrying on library work of a high order and for teaching in the library training courses.

The Liga Nacional Filipina para la Proteccion de la Primera Infancia in its report submitted on October 15, 1916, says: "We believe it our duty to call the attention of the Philippine Legislature to the small sum of ₱1,706.22, which is all that remains of the amount appropriated by Act No. 2376, and this is insufficient for the production of the necessary amount of tiqui-tiqui extract during next year. We recommend that beginning with 1917 a sum of not less than ₱2,000 be appropriated annually for the manufacture by the Bureau of Science of extract on a large scale * * *.¹ As shown on page 16 the preference of the "Liga" and other agencies for the extract made by the Bureau of Science is a commendable appreciation of the quality of our product. Since the above-quoted report was written, the "Liga" has taken steps toward extending its activities in the provinces, and the sum mentioned above should be probably doubled. It is recommended that the tiqui-tiqui plant be enlarged in order that no request for this extract need be refused. Provision should be made whereby all legitimate requests for the extract can be complied with by the Bureau of Science.

Tables showing the routine work performed and supplies manufactured and disposed of during the calendar year 1916 by the Bureau of Science, and the financial statement showing the appropriation and how it was expended, are attached hereto.

Respectfully submitted.

ALVIN J. COX,
Director, Bureau of Science.

To the Honorable
The SECRETARY OF THE INTERIOR.

¹ Translated from the Spanish.

TABLE I.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1916, as compared with the fiscal year 1915, by number or quantity and by value, arranged by subdivisions of the Bureau of Science.

Subdivision of the Bureau of Science.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
General, inorganic, and physical chemistry:						
Metals and alloys.....	44	25	18	24	243.00	144.00
Rocks, minerals, natural pigments, and similar substances.....	15	71		68		475.00
Clays, shales, limestones, limes, wall plasters, cement, and slags.....	5	10	2	2	23.00	23.00
Fertilizers.....	34	72	22	34	246.20	329.00
Soils and similar substances.....	365	18		3		25.00
Coal analyses.....	50	10	49	6	385.40	155.00
Calorimetric tests of fuels.....	34	7	34	3	672.00	96.00
Paints and varnishes.....		14		14		184.00
Waters.....	201	202	32	15	611.50	294.00
Crude chemical and miscellaneous analyses.....	135	166	115	157	497.00	499.00
Standard solutions (in liters).....	20	304	2	45	9.00	89.99
Physical test of wire, twine, fiber, textile, paper, and similar articles.....	32	4	32	3	87.00	12.00
Cements.....	6,716	15,790	6,696	15,676	9,427.15	12,015.80
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....	203	468	203	457	635.40	482.75
Standardization of road materials.....	71	67	71	67	467.40	410.10
Standardization of units of measure:						
Lengths.....	60	679	60	679	6.00	247.75
Capacities.....	121	56	121	56	27.10	83.60
Weights.....	31	20	31	20	16.95	23.85
Miscellaneous.....	22	79	22	78	15.50	162.10
Total.....	8,159	18,062	7,510	17,407	13,374.60	15,751.94
Organic chemistry:						
Urines, clinical and toxicological analyses.....	192	196	80	110	274.00	393.00
Essential oils and essences.....	11	10	11	10	77.50	71.00
Petroleum and products, copra, and similar materials.....	20	60	10	36	98.00	461.50

TABLE I.—Comparative table of routine work performed and supplies manufactured and disposed of, etc.—Continued.

Subdivision of the Bureau of Science.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
Organic chemistry—Contd.						
Linseed oils	63	17	54	6	412.65	103.00
Gums, resins, and similar materials	1	2	1	2	5.00	20.00
Paper and similar materials	117	135				
Gastric juice, clinical examinations	2	5	2	2	95.00	8.00
Foods and alcohols and beverages	2,921	1,164	245	123	951.20	147.67
Food preservatives and coloring matters	25	27	15		89.00	
Medicines and similar articles	120	120	24	54	485.00	651.60
Miscellaneous chemical analyses and examinations	178	25	36	16	298.04	122.00
Total	3,650	1,761	478	359	2,785.39	1,977.77
Mines:						
Assays	677	518	650	507	957.76	1,341.50
Biological laboratory:						
Fæces	50,021	266,676	1,118	171	3,352.33	427.00
Sputum	85	330	21	46	63.00	138.00
Blood	29	47	22	22	210.00	148.00
Culture	2	4	2	4	10.00	25.00
Widal test	5,166	615	6	2	18.00	6.00
Wassermann test	633	1,689	257	239	2,502.88	2,390.00
Leprosy	569	555		1		3.00
Urines	2	5	1		25.00	
Gonococci	15,832	17,169	10	32	30.00	96.00
Waters	2,986	4,108	11	12	350.00	309.00
Necropsies	117					
Histological examinations	473	7	13		130.00	60.00
Rabies	21	18				
Plague	1					
Rats for plague	79,298	69,556				
Miscellaneous biological examinations	10,035	4,866	9	13	48.00	94.00
Total	165,270	365,645	1,470	548	6,739.21	3,696.00

TABLE I.—Comparative table of routine work performed and supplies manufactured and disposed of, etc.—Continued.

Subdivision of the Bureau of Science.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
Serum section of the biological laboratory:						
Vaccine virus (doses) ----	1,788,666	1,523,703	1,788,666	1,523,703	18,976.60	17,417.80
Mallein (doses) ----	10	707	10	707	10.00	707.00
Miscellaneous sera and preparations (cubic centimeters) ----	9,520,841	2,720,437	5,208,940	2,720,437	12,785.00	8,316.67
Total ----	6,997,617	4,244,847	6,997,616	4,244,847	31,771.60	26,441.47
Miscellaneous:						
Photographs ----	4,971	4,916	4,020	3,500	1,403.60	1,275.45
Natural history specimens ----	82	24	82	24	208.48	451.38
Shop work ----	182	337	20	13	135.32	69.88
Miscellaneous work ----	17	69	17	69	5,249.94	8,343.44
Supplies ----		1,146		1,146		1,867.46
Sales of publications ----					4,548.99	3,551.42
Refunded work not done, etc. (deducted) ----					(102.50)	(202.61)
Power, gas, etc. ----					31,125.23	16,769.98
Total ----	5,252	6,492	4,139	4,752	42,569.06	32,126.40
Grand total ----	7,180,625	4,637,325	7,011,863	4,268,420	98,197.62	1,335.08

TABLE II.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1916, as compared with the fiscal year 1915, by number or quantity and by value, arranged with reference to Government and other patronage.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
Bureau of Agriculture:						
Fertilizers.....	9	38				
Soils and similar substances.....	363	13				
Crude chemical and miscellaneous analyses.....	1	5		3		3.00
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....		3		3		3.00
Foods and alcohols and beverages.....	29	34				
Miscellaneous chemical analyses and examinations.....	123					
Standard solutions.....	1		1		5.00	
Photographic work.....	16	2	16	2	11.09	1.80
Total.....	542	95	17	8	16.09	7.80
Bureau of Civil Service:						
Photographic work.....		85		85		17.00
Bureau of Coast and Geodetic Survey:						
Gonococcus.....		1				
Vaccine virus.....		100		100		1.00
Miscellaneous sera and preparations.....	320	90	320	90	128.00	36.00
Total.....	320	191	320	190	128.00	37.00
Bureau of Customs:						
Metals and alloys.....	4					
Waters, chemical.....	1					
Waters, biological.....	51	80				
Petroleum and products, copra, and similar materials.....	1	1				
Linseed oils.....	1	1	1		4.00	
Medicines and similar articles.....	9	1				
Fæces.....		45				
Sputum.....		1				
Rabies.....		1				
Miscellaneous biological work and examinations.....		1				
Total.....	67	131	1		4.00	

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.—Continued.*

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
Bureau of Education:						
Fertilizers	2					
Foods and alcohols and beverages	1					
Photographic work		28		28		24.30
Supplies		7		7		26.00
Total	3	35		35		50.30
Executive Bureau:						
Soils and similar substances		2				
Photographic work	625	253	625	253	182.24	44.37
Total	625	255	625	253	182.24	44.37
Bureau of Forestry:						
Soils and similar substances	2					
Photographic work	156	188	156	188	33.99	28.56
Total	158	188	156	188	33.99	28.56
Philippine Health Service:						
Metals and alloys	1					
Clays, shales, limestones, limes, wall plasters, cements, and slags		1				
Waters, chemicals	14	7				
Waters, biological	1,062	2,862				
Crude chemical and miscellaneous analyses	6	1				
Cements		11		11		18.00
Fertilizers	1					
Urines, clinical and toxicological analyses	107	85				
Petroleum and products, copra, and similar materials	2	4				
Linseed oils	5	1				
Gastric juice, clinical examinations		2				
Foods and alcohols and beverages	2,597	957				
Food preservatives and coloring matters	10	27				
Medicines and similar articles	73	52				
Miscellaneous chemical analyses and examinations	2	7		2		4.10
Fæces	20,262	140,484				
Sputum	61	279				

TABLE II.—Comparative table of routine work performed and supplies manufactured and disposed of, etc.—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
Philippine Health Service—Continued.						
Blood.....	7	21				
Widal test.....	5,152	613				
Wassermann test.....	283	127				
Leprosy.....	569	552				
Urines.....	1	5				
Gonococci.....	15,822	17,136				
Necropsies.....	102					
Histological examinations.....	457	1				
Rabies.....	21	17				
Plague.....	1					
Rats for plague.....	79,032	69,221				
Miscellaneous biological work and examinations.....	10,021	4,811				
Vaccine virus.....	1,726,560	1,359,700	1,726,560	1,359,700	17,265.60	13,597.00
Miscellaneous sera and preparations.....	3,535,510	1,562,011	3,535,510	1,562,011	8,141.22	2,759.64
Photographic work.....	180	279	180	279	102.74	144.12
Shop work.....	1		1		8.66	
Total.....	5,397,922	3,159,274	5,262,251	2,922,003	25,518.22	16,522.86
Bureau of Internal Revenue:						
Standardization of weights.....	7	2	7	2	2.45	5.00
Urines, clinical and toxicological analyses.....	1					
Foods and alcohols and beverages.....		8				
Medicines and similar articles.....	9	7				
Petroleum and products, copra, and similar materials.....	1					
Photographic work.....		161		161		85.45
Total.....	18	178	7	163	2.45	90.45
Bureau of Justice:						
Gastric juice, clinical examinations.....	2		2		95.00	
Urines, clinical and toxicological analyses.....	1		1		20.00	
Medicines and similar articles.....	14	46	14	46	140.00	460.00
Blood.....	2	1	2	1	150.00	75.00
Total.....	19	47	19	47	405.00	535.00

TABLE II.—Comparative table of routine work performed and supplies manufactured and disposed of, etc.—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
Philippine Constabulary:						
Physical test of wire, twine, fiber, textile, paper, and similar articles	1		1		4.00	
Leprosy		2				
Miscellaneous biological work and examinations		1				
Vaccine virus	2,650	1,300	2,650	1,300	26.50	13.00
Miscellaneous sera and preparations	6	3,030	6	3,030	3.00	54.00
Photographic work	2		2		3.20	
Total	2,659	4,333	2,659	4,330	36.70	67.00
Philippine Exposition Board:						
Photographic work	49		49		140.00	
Bureau of Printing:						
Paper and similar materials	117	135				
Medicines and similar articles	2	1				
Linseed oils		1				
Total	119	137				
Bureau of Prisons:						
Gastric juice		1				
Medicines and similar articles		1				
Fæces	26,927	112,216				
Sputum	1					
Widal test	8					
Wassermann test	93	1,323				
Necropsies	15					
Histological examinations	3					
Waters, biological		9				
Miscellaneous biological work and examinations	5	31				
Photographic work		98		98		119.53
Total	27,052	113,679		98		119.53
Bureau of Public Works:						
Metals and alloys	3		3		29.00	
Crude chemical and miscellaneous analyses	6	19		19		57.00
Standard solutions (in liters)		87		11		20.87
Cements	2,014	1,692	2,014	1,692	3,257.10	2,936.60

TABLE II.—Comparative table of routine work performed and supplies manufactured and disposed of, etc.—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
Bureau of Public Works—Ctd.						
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.	6	110	6	110	24.00	121.95
Standardization of road materials	5	5	5	5	26.00	25.00
Paints and varnishes	8	2	8	2	94.50	36.00
Petroleum and products, copra, and similar materials	3					
Waters, chemical	146	139				
Waters, biological	106	26				
Photographic work	16		16		5.30	
Physical test of wire, twine, fiber, textile, paper, and similar articles	3		3		13.00	
Shop work	1		1		18.00	
Total	2,317	2,080	2,056	1,839	3,466.90	3,197.42
Bureau of Quarantine Service:						
Urines, clinical and toxicological analyses	1					
Fæces	1,693	13,517				
Sputum	2					
Rats for plague	266	335				
Vaccine virus	9,400	9,000	9,400	9,000	94.00	90.00
Photographic work		30		30		49.30
Total	11,362	22,882	9,400	9,030	94.00	139.30
Bureau of Science:						
Metals and alloys	20					
Rocks, minerals, natural pigments, and similar substances	15	2				
Clays, shales, limestones, limes, wall plasters, cement and slags	3	5				
Coal analyses	1	2				
Calorimetric tests of fuels		4				
Crude chemical and miscellaneous analyses	7	5				
Standard solutions (in liters)	18	183				
Cements	20	114				

TABLE II.—Comparative table of routine work performed and supplies manufactured and disposed of, etc.—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
Bureau of Science—Contd.						
Compression, tensile, or transverse strength of concrete, stone mortar, rope, iron and steel, etc.		2				
Petroleum and products, copra, and similar materials	2	4				
Urine, clinical and toxicological analyses		1				
Linseed oils	1	2				
Miscellaneous chemical analyses and examinations	6	2				
Waters, chemical	1	14				
Waters, biological	733	372				
Assays		5				
Miscellaneous biological work and examinations		4				
Miscellaneous sera and preparations	1					
Assays	27					
Photographic work	951	1,416				
Shop work	162	324				
Total	1,968	2,461				
Bureau of Supply:						
Metals and alloys	1	1				
Crude chemical and miscellaneous analyses		2		1		5.00
Standard solutions (in liters)	1	1	1	1	4.00	0.62
Physical tests of wire, twine, fibers, textiles, paper, and similar materials	10	1	10		31.00	
Cements	3,788	13,662	3,788	13,662	3,522.40	7,926.85
Paints and varnishes		7		7		120.00
Standardization of units of measures:						
Lengths	60	679	60	679	6.00	247.75
Capacities	121		121		27.10	
Weights	24	12	24	12	14.50	9.85
Miscellaneous	21	1	21		10.50	
Petroleum and products, copra, and similar materials	1	15				
Linseed oils	36	6	33		172.75	
Foods and alcohols and beverages	49	42				

TABLE II.—Comparative table of routine work performed and supplies manufactured and disposed of, etc.—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
Bureau of Supply—Contd.						
Medicines and similar articles	3	4				
Miscellaneous chemical analyses and examinations	7					
Waters, chemical	7	17				
Waters, biological	11	15				
Miscellaneous biological work and examinations		5				
Miscellaneous sera and preparations	10,064	23	10,064	23	45.60	9.70
Supplies		1		1		4.00
Total	14,204	14,494	14,122	14,386	3,833.85	8,323.77
University of the Philippines:						
Miscellaneous chemical analyses and examinations	1		1		18.34	
Fæces	21	243				
Miscellaneous sera and preparations		32,060		32,060		34.00
Photographic work	531	251	531	251	122.20	82.52
Shop work	3	1	3	1	24.84	8.27
Supplies		56		56		3.05
Total	556	32,611	535	32,368	165.38	127.84
City of Manila:						
Clays, shales, limestones, limes, wall plasters, cements, and slags		1		1		8.00
Crude chemical and miscellaneous analyses	35	6	35	6	43.00	78.00
Standard solutions (in liters)		13		13		48.50
Cements	108	82	108	82	416.35	308.70
Standardization of road materials		2		2		25.00
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.	12	10	12	7	11.00	14.00
Linseed oils		1		1		18.00
Miscellaneous chemical analyses and examinations	7		3		75.00	
Waters, biological	1,012	741				
Miscellaneous biological work and examinations	4		4		20.00	
Blood		4				

TABLE II.—Comparative table of routine work performed and supplies manufactured and disposed of, etc.—Continued.

Costumer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
City of Manila—Continued.						
Miscellaneous sera and preparations.....	168,532	150,001	168,532	150,001	200.50	152.40
Total	169,710	150,867	168,694	150,113	765.85	652.60
Provinces and municipalities:						
Metals and alloys.....		4		4		28.00
Crude chemical and miscellaneous analyses.....	6	16	6	16	29.50	252.00
Cements.....	510	23	510	23	668.00	201.65
Clays, shales, limestones, limes, wall plasters, cements, and slags		3		1		15.00
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....	60	323	60	323	403.40	310.80
Coal analyses.....		1		1		35.00
Standardization of road materials	60	54	60	54	403.40	290.60
Medicines and similar articles		3		3		70.00
Waters, chemical.....		2		1		6.00
Vaccine virus	30,000	80,000	30,000	80,000	900.00	2,400.00
Miscellaneous sera and preparations.....		53,525		53,525		1,559.74
Photographic work.....	198		198		66.75	
Paints and varnishes.....	2	1	2	1	31.00	8.00
Total	30,836	133,955	30,836	133,952	2,502.05	5,176.79
United States Army and Navy:						
Metals and alloys.....	4	1	4	1	40.00	24.00
Coal analyses.....	43		43		293.40	
Calorimetric tests of fuels.....	23		23		352.00	
Waters, chemical.....	1		1		40.00	
Waters, biological	2		2		80.00	
Physical tests of wire, twine, fibers, textiles, paper, and similar articles.....	8		8		12.00	
Cements.....	61	48	61	48	328.50	240.00
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....	13	6	13	6	22.00	19.00

TABLE II.—Comparative table of routine work performed and supplies manufactured and disposed of, etc.—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
United States Army and Navy—Continued.						
Crude chemical and miscellaneous analyses.....	1	5	1	5	5.00	36.00
Urines, clinical and toxicological analyses.....		1		1		50.00
Standardization of units of measures.....	1	6	1	6	5.00	9.00
Petroleum and products, copra, and similar materials.....	1	3	1	3	15.00	83.00
Linseed oils.....	2	3	2	3	30.00	45.00
Foods and alcohols and beverages.....	6	5	6	5	78.00	50.00
Miscellaneous biological work and examinations.....		1		1		3.00
Vaccine virus.....	18,330	21,410	18,330	21,410	588.50	685.00
Mallein.....	10	707	10	707	10.00	707.00
Miscellaneous sera and preparations.....	767,744	448,927	767,744	448,927	1,763.80	1,620.85
Supplies.....		253		253		77.45
Total.....	786,250	471,376	786,250	471,376	3,663.20	3,649.30
Miscellaneous:						
Metals and alloys.....	11	19	11	19	174.00	92.00
Clays, shales, limestones, limes, wall plasters, cements, and slags.....	2		2		28.00	
Rocks, minerals, natural pigments, and similar substances.....		69		68		475.00
Fertilizers.....	22	34	22	34	246.20	329.00
Soils and similar substances.....		3		3		25.00
Coal analyses.....	6	7	6	5	92.00	120.00
Calorimetric tests of fuels.....	11	3	11	3	320.00	96.00
Crude chemical and miscellaneous analyses.....	73	107	73	107	419.50	68.00
Paints and varnishes.....		4		4		20.00
Physical tests of wire, twine, fibers, textiles, paper, and similar articles.....	10	3	10	3	27.00	12.00
Standard solutions (in liters).....		20		20		20.00
Cements.....	215	158	215	158	1,234.80	384.00

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.—Continued.*

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
Miscellaneous—Continued.						
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	112	8	112	8	175.00	14.00
Standardization of road materials	6	6	6	6	38.00	69.50
Standardization of units of measures (capacities)		56		56		83.60
Miscellaneous inorganic analyses		78		76		158.00
Urines, clinical and toxicological analyses	82	109	79	109	254.00	343.00
Essential oils and essences	11	10	11	10	77.50	71.00
Petroleum and products, copra, and similar materials	9	33	9	33	83.00	378.50
Linseed oils	8	2	8	2	80.40	40.00
Gums, resins, and similar materials	1	2	1	2	5.00	20.00
Gastric juice, clinical examinations		2		2		8.00
Foods and alcohols and beverages	239	118	239	118	873.20	97.67
Food preservatives and coloring matters	15		15		89.00	
Medicines and similar articles	10	5	10	5	345.00	121.60
Miscellaneous chemical analyses and examinations	32	16	32	16	204.70	122.00
Assays	650	513	650	507	957.76	1,341.50
Waters, chemical	31	14	31	14	571.50	288.00
Waters, biological	9	12	9	12	270.00	309.00
Fæces	1,118	171	1,118	171	3,352.33	427.00
Sputum	21	50	21	46	63.00	138.00
Blood	20	21	20	21	60.00	73.00
Culture	2	4	2	4	10.00	25.00
Widal test	6	2	6	2	18.00	6.00
Wassermann test	257	239	257	239	2,502.88	2,390.00
Leprosy		1		1		3.00
Urines	1		1		25.00	
Gonococci	10	32	10	32	30.00	96.00
Histological examinations	13	6	13	6	130.00	60.00

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.—Continued.*

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1915	1916	1915	1916	1915	1916
Miscellaneous—Continued.						
Miscellaneous biological work and examinations.	5	12	5	12	28.00	91.00
Vaccine virus	1,726	52,193	1,726	52,193	102.00	631.80
Miscellaneous sera and preparations	726,764	470,770	726,764	470,770	2,502.88	2,090.34
Photographic work	2,247	2,125	2,247	2,125	736.09	678.50
Natural history specimens	82	24	82	24	208.48	451.38
Shop work	15	12	15	12	83.82	61.61
Miscellaneous work	17	69	17	69	5,249.94	8,343.44
Supplies		829		829		1,756.96
Sales of publications					4,548.99	3,551.42
Refunded, work not done, etc. (deducted)					(102.50)	(202.61)
Power, gas, etc.					31,125.23	16,769.98
Total	733,869	527,971	733,866	527,956	57,239.70	42,548.19
Grand total	7,180,625	4,637,325	7,011,863	4,268,420	98,197.62	81,335.08

TABLE III.—Comparative statement showing expenditures and income during the fiscal year 1916 (January 1 to December 31, 1916) as compared with the fiscal years 1914 and 1915.

EXPENDITURES.

Item.	Fiscal year		
	1914	1915	1916
Salaries and wages, etc.:	<i>Pesos.</i>	<i>Pesos.</i>	<i>Pesos.</i>
Salaries and wages including accrued leave	224, 113. 73	191, 349. 75	231, 180. 22
Traveling expenses of personnel	14, 212. 98	12, 026. 16	12, 964. 40
Total	238, 326. 71	203, 375. 91	244, 144. 62
Apparatus, supplies, etc.:			
Consumption of supplies and materials including sub- scriptions	74, 407. 70	73, 156. 96	72, 929. 96
Apparatus and equipment including books	25, 450. 77	14, 448. 88	21, 429. 44
Total	99, 858. 47	87, 605. 84	94, 359. 40
Miscellaneous:			
Rental of buildings	720. 00	682. 50	481. 50
Postal, telegraph, telephone, and cable service	4, 932. 12	4, 764. 62	3, 990. 65
Freight, express and delivery service	980. 09	1, 176. 32	1, 725. 92
Printing and binding reports, documents and publica- tions	28, 695. 67	33, 590. 61	21, 238. 19
Illumination and power service	402. 53	1, 647. 02	1, 628. 53
Contingent service	3, 631. 71	3, 079. 95	4, 520. 06
Maintenance and repairs of furniture and equipment	712. 92	4, 409. 75	4, 200. 00
Total	40, 075. 04	49, 350. 77	37, 784. 85
Grand total	378, 260. 22	340, 332. 52	376, 288. 87

INCOME.

Receipts from operation	115, 486. 73	98, 197. 62	81, 335. 08
Prior year income	(838. 20)	2, 665. 88	647. 89
Sales of supplies	488. 82	. 73	
Sales of fixed assets	2, 716. 45	25, 889. 93	1, 575. 70
Total	117, 853. 80	126, 754. 16	83, 558. 67
Appropriation account:			
Appropriated	381, 084. 00	360, 895. 50	371, 976. 00
Allotted by the Emergency Board		10, 000. 00	25, 000. 00
Brought forward for accounts payable	68, 586. 98	58, 891. 87	27, 856. 39
Restored from previous fiscal years	9, 834. 35		20, 039. 31
Total	459, 505. 33	429, 787. 37	444, 871. 70

MISCELLANEOUS ACCOUNTS (1916).

Item.	Available.	Expended.	Balance.
Tiqui-tiqui distribution, Act No. 2376	3, 532. 64	2, 590. 21	942. 43
Improvement of the Aquarium, Act No. 2494	2, 000. 00	1, 918. 27	81. 73
Replacement fund	5, 064. 45	2, 280. 02	2, 784. 43
Total	10, 597. 09	6, 788. 50	3, 808. 59

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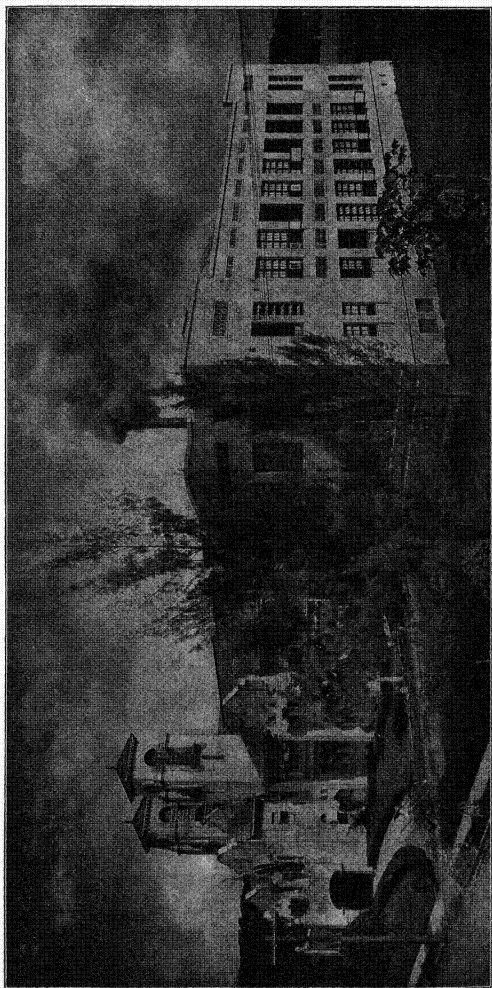


PLATE I. THE MAIN BUILDING OF THE PHILIPPINE BUREAU OF SCIENCE.

BOUND

NOV 28 1959

**UNIV OF MICH.
LIBRARY**



PHILIPPINE
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